New
3-VOL

Waldo A. Learned

PROCEEDINGS

OF THE

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

AT THE

THIRTY-SECOND AND THIRTY-THIRD ANNUAL MEETINGS.

PARKER HOUSE AND YOUNG'S HOTEL,
BOSTON, MASS.,
February 19 and 20, 1902, and
Feb. 18 and 19, 1903.

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PROCEEDINGS

OF

THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,

Thirty-Second Annual Meeting, Feb 19 and 20, 1902.

Held at the Parker House, Boston, Mass.

First Day, Feb. 19 — Morning Session.

The meeting was called to order by the President, Mr. Waldo A. Learned, of Newton, with Mr. N. W. Gifford, of New Bedford, Secretary.

Routine Business.

The President having extended a cordial welcome to those present as visitors to take active part in the proceedings, a motion to dispense with the reading of the minutes of the last meeting was adopted. The Secretary read the following

Report of the Board of Directors.

To the Members of the New England Association of Gas Engineers:

Your Directors would present the following report: They have received the following applications for membership in the Association and recommend them for election:

Active:

Barnes, W. I., General Superintendent Bristol County Gas and Electric Company, Providence, R. I.
Blodget, C. W., Engineer, Providence (R. I.) Gas Company.
Campbell, A. J., General Manager, Norwich (Conn.) Gas and Electric Company.

Ellis, J. W., President Providence (R. I.) Gas Company.

Fish, R. O., Supt., Taunton (Mass.) Gas Light Company.

McKnight, G., Supt., Athol (Mass.) Gas and Electric Company.

Slater, H. O., Gas and Mechanical Engineer, Boston, Mass.

[illegible], C. F., Asst. Supt., Haverhill (Mass.) Gas Company.

Tenney, A. B., Supt., Suburban Gas and Electric Company, Everett, Mass.

Walker, E. M., Superintendent and Secretary, Dedham and Hyde Park (Mass.) Gas and Electric Light Company.

Associate:

[illegible], F. V., Home Science Pub. Company, Boston, Mass.

[illegible], E. H., Treas., Lynn (Mass.) Gas and Electric Company.

[illegible] Griswold, C. S., Foreman, Meriden (Conn.) Gas Light Company.

[illegible], C. H., Manager, Welsbach Company, New England Department, Boston, Mass.

[illegible], W. A., Salesman, Abendroth Bros., Newton, Mass.

[illegible], F. de V., General Manager, Springfield (Mass.) Gas [illegible] Company.

[illegible] following papers have been read and approved for your [illegible] and discussion:

"[illegible] Advantages of the Card System in the Gas Ledger;" by [illegible], Cambridge, Mass.

"[illegible]" by C. S. Griswold, Meriden, Conn.

"[illegible] Treatment;" by A. B. Slater, Jr., Boston, Mass.

"[illegible] Artificial Gas at High Pressure in a Suburban [illegible]" by George F. Goodnow, Waukegan, Ills.

"[illegible] of the Operation of a Lowe Water Gas Appar[illegible]" by C. F. Leonard, Fall River, Mass.

"[illegible] Foundation for Steel Holder Tank on Quicksand [illegible]" by C. A. Learned, Meriden, Conn.

"[illegible] Company?" by F. S. Richardson, No. Adams,

"Gas Engines;" by George F. Macmun, Jr., Pawtucket, R. I.

"A Model Coal Shed;" by Thomas H. Hintze, Lowell, Mass.

The Secretary has been instructed to call the attention of members whose annual dues are in arrears to Article 12 of the Constitution.

On motion, the report was accepted.

ELECTION OF NEW MEMBERS.

On motion of Mr. Leach, the Secretary was instructed to cast the ballot of the Association in favor of the election to membership of those recommended for such election in the report of the Directors. The Secretary having reported that the instructions had been obeyed, the President welcomed the new members to seats in the convention and expressed the hope that they would take active part in the proceedings. The President appointed Messrs. H. F. Coggeshall, W. G. Africa and W. H. Snow a committee to introduce the new members individually to other members of the Association as occasions for such introductions were presented.

REPORT OF SECRETARY.

At the last annual meeting there were added to the rolls 12 active and 19 associate members, and there was 1 transfer from associate to active. Two resignations were accepted.

There have been lost during the year by death 3, by resignation 1, by failure to qualify after election 1, making a total (201), February 17, 1902, on the rolls of 9 honorary, 138 active and 54 associate members.

According to the instructions of the Association at the 31st Annual Meeting, there have been printed and distributed to the members 300 copies of the "Proceedings" for 1900 and 1901. The Secretary wishes to acknowledge the kindness of the *American Gas Light Journal* and its genial Manager in loaning cuts and other assistance in this work.

N. W. GIFFORD, *Secretary.*

REPORT OF TREASURER.

Balance Feb. 16, 1901,	$449.99	
Received for dues 1900,	15.00	
" " " 1901,	129.00	
" " " 1902,	341.00	
Admission Fees,	80.00	
Sale of Badges,	4.00	
" " Proceedings,	18.00	
" " Banquet Tickets,	321.00	
From Savings Bank,	200.00	
Interest,	2.95	
		$1560.94
Paid for Music,	$12.00	
Express,	2.25	
Boston Elevated Railway,	15.00	
Telegraph and Telephone,	7.52	
J. R. Whipple & Co.,	454.55	
Printing,	127.85	
Salary,	200.00	
Flowers,	45.00	
Postage,	15.83	
Proceedings,	516.14	
Sundries,	7.86	
Balance,	156.94	
		$1560.94

N. W. GIFFORD, *Treasurer.*

The report of the Treasurer, having the endorsement of the Auditing Committee, both were received and ordered filed.

Vice-President McKay took the Chair, and President Learned read the following inaugural address:

INAUGURAL ADDRESS.

Fellow Members of the New England Association of Gas Engineers:

The past year has been one of prosperity in the gas industry. Our business is a barometer of prosperous conditions as the iron market is to the commercial world. It is not my intention to review the past history of the gas business, or expatiate on the future, but present a few facts affecting our industry at the present time. The rapid growth of the business requires marked ability on the part of the gas engineer to plan judiciously for the future. Care must be taken that old methods and apparatus must not be discarded until satisfied that the gain is sufficient to warrant the changes made. The engineer must keep in touch with methods adopted in other industries, seeing if they can be applied to his own with profit; his practical knowledge and experience will be his best guides to the adoption of such methods. He must add to his many duties the commercial methods of doing business with his customer. The future development of our industry depends more upon this branch of the business than upon improvements in manufacture.

We must educate our patrons to obtain the best results from gas, both for lighting and other purposes. We reduce the cost at the meter and neglect the customer. When one pays for gas delivered at the meter he is entitled to receive it under such conditions as to reap the highest benefit from his appliances, which should be sold at the lowest figure, but not at a loss.

To render incandescent burners more popular greater attention should be paid to them after installation. A systematic inspection that would be self-supporting might be adopted; then the best mantles could be used and a supervision maintained over the general lighting of the house and appliances therein. A house-to-house canvass will convince all how little the public know about gas appliances. The public has been fooled so often by the purchase of poor burners and governors that it is time for gas companies to act for the education of their patrons.

Incandescent burners are increasing in efficiency and attractive features, but they can never give satisfaction under variable

gravity between 29° and 34° B. Where Texas oil has been used for the manufacture of gas it is not as efficient by 20 per cent. as gas oil. In a water gas plant the best conditions exist for making bisulphide of carbon from the sulphur in the oil, for the removal of which no provision is made in our present method of purification. Oil that contains 1½ per cent. sulphur, or gas coal containing 3 per cent. sulphur cannot be used for gas manufacture in Massachusetts, and come within the requirements of the law, which states that there shall not be more than 20 grains of sulphur in 100 feet of gas. The danger in a steam plant from the use of oil, coal and coke containing a large quantity of sulphur, is the corrosion of the iron in the horizontal flues and unlined iron chimney, which is an excellent air condenser, especially when the flue temperatures are low and the fires banked. More attention should be paid to the quality of the materials that we purchase. If gas oil is to be bought the principal consideration is to obtain oil which upon fractional distillation will not show any marked variations in the gravity of the distillates. The quality of the oil is but slightly affected by gravity, provided the heats are suited to it. A large quantity of gas oil on the market is composed of heavy oil cut back with a light product to a gravity of 38° to 40° B. We have different oils in the mixture; naphtha, that requires a very low heat and heavy oil that necessitates a high heat for its gasification. We try to obtain a heat that will fulfil all these conditions, but it is impossible. The naphtha is first gasified by a low heat to prevent lampblack and not high enough to make gas out of the heavy parts of the oil. The result is that 12 to 15 per cent. of the oil gasified is tar, and 30 per cent. of the tar is oil lighter than water.

Analysis of Two Gas Oils of the Same Gravity, but of Different Composition.

No. 1.—Specific gravity, 39° B., 0.8285, at 60° F.

Temperature, Degs. F.	Per Cent. Weight.	Degs. B.	Sp. Gr. at 60° F.
320 to 450	8.85	63	.7254
450 to 500	4.64	51	.7735
500 to 550	6.25	47	.7099
550 to 580	6.25	44	.8046
580 to 600	7.70	42	.8139
600 to 660	24.43	37.5	.8360
Residue	40.10	32.5	.8611
	98.22		

No 2.

Temperature, Degs. F.	Per Cent. Weight.	Degs. B.	Sp. Gr. at 60° F.
490 to 540	16.25	45.5	0.7097
540 to 564	15.62	42	0.8139
564 to 620	16.25	41	0.8187
620 to 700	15.	40	0.8234
700 and beyond	16.50	39	0.8285
Residue	18.37	35.5	0.8459
	97.99		

The excessive demands for gas coal have caused the shippers to be more careless in the preparation and selection of their coal, probably seeking mines of poorer quality. These different coals are mixed at tidewater. The result is that the sulphur in the so-called standard coals has increased considerably. Iron in the coal shows itself in the coke, and we are fully aware of its presence in the clinker of the coke in the water gas generator. The sulphur in gas coal distributes itself depending upon the amount of moisture in the coal. With dry coal about one-half of the sulphur goes into the gas and the balance into the coke. If the coke is used in the manufacture ot water gas then the largest portion of the sulphur passes into the gas. It is important that the coal should be as free from it as possible, especially in manufacturing under Massachusetts laws.

The value of gas coal should be determined by the quantity of tar, coke, liquor and gas produced, by adopting prices based on your residual market, comparison being made by the ordinary rule of proportions. It does not follow that the coal that produces the largest amount of gas is the cheapest, especially where there is an auxiliary water gas plant.

The tar market has been low the past year, but the prices are very firm at present. A large amount of tar has been used for macadamized roads, which are beyond the experimental stage. The success of these roads depends more upon the selection of the materials and their proper sizes than upon the tar which is used as a cement. A large amount of tar is also used to mix with coke oven tar to increase its density for concrete purposes and for making pitch. Notwithstanding the large amount of tar produced in this vicinity, 8,635 barrels of pitch were imported into the port of Boston this past year. The Gas Commissioners' report shows a high price realized from the sale of water gas tar. Maintain the high standard of your coal tar. The paper by Mr. C. F. Prichard, on

"The Fuel Value of Residuals,"* read at the last meeting of the American Gas Light Association, should command your closest thought. It teaches you how to utilize your tar to the best advantage. Under my conditions of manufacture the best evaporative results are obtained with a mixture of $1\frac{1}{2}$ barrels of water gas tar to a ton of breeze, the fuel being $\frac{1}{3}$ tar breeze and $\frac{2}{3}$ bituminous coal, used in the common boiler furnace.

This tar mixture has the property of burning the worst case of clinker to an ash that can be found in a poor quality of coal or coke.

Spent oxide has been sold in this market as high as $3.50 per ton, depending upon the amount of cyanogen in the material, the quantity of the sulphur not being considered. The same price has been realized under a yearly contract. The oxide is used in fertilizing material, and the price is based on the percentage of ammonia.

Gas distribution has come to be a difficult matter, with the increasing demands for gas and the large number of pipes in our streets. The tendency is to increase the pressure in our territory to aid distribution, and with it must come the introduction of governors in houses, even if they have to be put in as the property of the company, in connection with the meter. There is no reason why the pressure in your distributing system should be kept low. There is no necessary relation between the amount of pressure in your territory and your leakage. If there is such a relation it is due to bad management. Make a systematic inspection yearly and repair your leaks, and the percentage of loss will be reduced to a low figure.

If the holders are not of sufficient weight to give the required pressure use a high pressure, fan exhauster. This exhauster can be used to transfer the gas from a light to a heavy holder, from the works to the holder, or to increase the street pressure. The exhauster, by its centrifugal action, is a perfect mixer of gases, with no pulsations or variation in pressure. I will tell you what other uses it can be put to. A naphthaline stoppage occurred in our main line of pipe, one-quarter of a mile from the works. A large quantity of oil was introduced in the pipe through the services and the street lamps, but with no apparent effect. The gas exhauster was started, feeding gas in the whole pipe system. A mixture of kerosene and

*See *American Gas Light Journal*, Nov. 18, 1901; p. 807.

[illegible] introduced into the inlet of the exhauster through [illegible]. The speed was 3,000 revolutions per min- [illegible] was a perfect atomization of the oil in the [illegible] broke down the naphthaline, and normal [illegible] to the system.

[illegible] apparatus (I hope you will never be in a [illegible] Three years ago, while running [illegible] to determine the effect of the rate of [illegible] by certain unforeseen events which oc- [illegible] holder was permeated with sulphuretted [illegible] was shut off and the city was supplied [illegible] increasing the street pressure with the [illegible] with 750,000 feet of foul gas caused [illegible] A solution of sulphate of iron and caustic [illegible] the exhauster through sight-feed cups, [illegible] through the inlet and outlet pipes, [illegible] the holder. In 10 hours the gas was [illegible] hydrogen.

[illegible] by small pipes is receiving the [illegible] might be adopted to increase the [illegible] district a long distance from the works, [illegible] line and reducing the pressure, by an [illegible] to that of your low pressure sys- [illegible] holders. You are all aware what [illegible] done for us in this line, and thanks are [illegible] and liberality in giving to us the [illegible]

[illegible] should be paid by gas engineers to electro- [illegible] which is becoming more troublesome every [illegible] survey of your territory should be made [illegible] point current is passing into or out of [illegible] locate the acute danger section and such [illegible] the findings may warrant. The determin- [illegible] of electricity is generally unsatisfactory. [illegible] the milli-ampere meter is connected be- [illegible] the pipe, say about 8 feet apart, and the [illegible] the instrument. By knowing the re- [illegible] the quantity is worked out, and checked [illegible] pipe and measuring the actual quantity [illegible] opening of the pipe line. The results are [illegible] the moment the earth is covered about

the pipe all the conditions change and your results are approximate. Such is not the case with a voltmeter, which will show the difference in potential between the pipes, rails and hydrants and the direction of flow of current of electricity in the pipes. These measurements can be taken by your foreman and results worked up at the office.

It was supposed that the principal danger only occurred near the power houses, where the current left the pipe to the negative pole of the dynamo, but it takes place at any point in the pipe system where the electricity leaves the pipes to a medium of less resistance, especially when the soil is of an alkaline or acid nature. Electrolysis generally shows itself near the joints where the current has passed around it. Wrought iron and lead pipes are more susceptible to its action than cast iron. Gas pipes laid with lead joints have 15 per cent. greater resistance than water pipes under the same condition. Electrolysis can be detected by the graphitic condition of the pipe. Screwed joints in wrought iron pipes have about the same resistance as lead joints in cast iron pipes of the same diameter.

A large number of tests were made at our station to determine the resistance of joints of different material under different conditions, to see if some light could not be thrown upon the subject which would be of interest to gas companies. The conclusions were that all possible resistance should be inserted into the mains by making the joints of some insulating or semi-insulating material, protecting all pipes where they pass in proximity to other conductors of electricity by some waterproof, insulated covering material, and by any other means to break up the system into as many metallic units as possible, insulated from all other pipe or trolley systems as far as practical and mechanical conditions may allow. It can be said that joints of cast iron pipe, made with Portland cement and with an asbestos or paper ring placed between the abutting ends of the pipes, give a joint of very high resistance, depending upon the amount of moisture the cement will take up after setting. The resistance of a cement joint as ordinarily made is from 15,000 to 20,000 times the resistance of a lead-caulked joint, comparing pipes of equal diameter.

All pipes passing at right angles to pipes or rails conveying electricity may act to a great extent as feeders to the main

system. While the painting of pipes is found in many cases to delay or diminish electrolysis, we cannot depend upon a coat of paint as an insulating covering for pipes, notwithstanding the insulating qualities of the paint. From tests made for an easily applied waterproof insulator, for covering gas pipes crossing under tracks and pipes charged with electricity, it was found that cement covering was worthless on account of the absorption of moisture and its non-elastic qualities, but that a covering made of three parts of dry sand and two parts of tar, boiled to a pitch at 350° C., would make a mixture slightly elastic at ordinary temperature, and which applied to the surface of the pipes to a depth of 1½ inches was thoroughly waterproof and had an insulating resistance of over one million ohms to the cubic inch. A short piece of two-inch pipe covered with this mixture was immersed in a strong solution of water and soda ash for eight hours. At the end of that time it showed no signs of absorption of any solution, nor had any decrease of electrical resistance developed.

The study of the question will enable you to see the parts of the territory most affected and the changes that are taking place from time to time, opening up a wide field of study and teaching the best method of putting resistance into your system. The destruction of the pipes is not the only trouble that gas companies will have to contend with, but the likelihood of explosions, whenever opening or closing the gas pipe line conducting electricity. The remedy would be to connect each side of the opening with copper wire until the connections are made. Serious accidents from this cause have been reported the past year. Partial relief can be obtained if the power companies bond their rails and connect them at certain intervals to the return wire to their stations, but electrolysis will occur as long as any part of the rail circuit is in the ground. Bonding the rail only increases the length of time when electrolysis will show its effects.

A complete metallic circuit is the only remedy, and the trouble is to induce the railroads to adopt it. There should be intelligent co-operation between the different companies that use the earth in connection with their business.

Through the efforts of my predecessor last year this Association made a marked increase in membership. I hope that you individually will have the welfare of the Association at heart to

endeavor to increase our numbers. An increase in membership will keep the dues at the present low figure and yield sufficient funds to print the proceedings. The smaller companies should be induced to send a representative.

If it were simply the reading of the papers, that could be acquired at home through the medium of the different gas journals; but it is friendly intercourse between man and man, with his varied opinions upon the difficulties that arise from day to day, with new ideas and new methods of operation, that are of inestimable value to all companies.

How unpleasant it is to record "deceased" against the names of the members who have passed from us: but such is the course of human events.

F. C. BLOOD, died February 24, 1901.

D. W. CRAFTS, died March 12, 1901.

G. B. NEAL, died July 7, 1901.

"The faults of our brothers we should write upon the sands; their virtues upon the tablets of love and memory."

With your approval, a fitting tribute of respect to their memory will be inscribed upon the records.

To the members who have kindly prepared papers to be read at this meeting I tender my sincere thanks. For the honor of having been called to preside over the affairs of the Association I feel deeply grateful.

COMMITTEE ON PRESIDENT'S ADDRESS.

On motion of Mr. Allyn the address was referred for consideration and report to a committee of three, the members of the committee as named by Vice-President McKay being Messrs. C. F. Prichard, S. J. Fowler and W. H. Snow.

COMMITTEE TO NOMINATE OFFICERS.

Following a motion by Mr. McGregor the President appointed Messrs. H. A. Allyn, J. A. Gould and Walter F. Norton a committee to nominate officers for the ensuing year.

Mr. Shelton on the Proposed Indexing by the Western Gas Association.

The President.— Has any member anything to offer for the good of this Association?

Mr. Shelton.— Mr. President and Gentlemen: I think the President must have expressed that purposely, because he knew that I wanted to bring before this Association something that I think will appeal to you as for the good of the membership of the Association. I refer to a work that has been started in this past year by the Western Gas Association, and which has been sufficiently broadened in its scope so that the members of the various Gas Associations can, however, share in the benefits of it. About a year ago the library bequeathed by Mr. George Treadway Thompson to the Western Gas Association was put into the hands of a committee, with the idea that that committee should on it as a nucleus, build up and create a definite source of reference on all gas subjects that have appeared in print. It was felt further that the greater portions of gas subjects of a practical working nature are the articles that appear in the several gas journals in England and in America. It was felt logically that no reference source of information would be adequate as a practical working thing unless it had an index of such, and the various articles that have appeared in print upon any gas topic of any moment.

The committee of the Western Gas Association has, therefore, undertaken to prepare an index of all principal and current practical gas literature. You can see that that is a rather comprehensive, broad and ambitious work. It was then decided to make that index of such a character that the various subscribers to it of the Western Gas Association could get duplicate copies of it. It would do the membership very little good to have an index of what was available in the way of information in printed matter in New Albany, Ind., if they could not get there or could not find out what was contained in the index. Going a step further, it was decided to make that record in *duplicate printed form* of "card index" character. In short, the work has advanced far enough to assure the completion of 100, 150 or 200, as the case may be, complete sets of card indexes of all the practical articles on gas.

I think you will agree with me that the great trouble in our working system of back papers is that we forget what has been brought out. For instance I just happen to remember that ten years or more ago Mr. H. C. Adams, of the Westmoreland Coal Company, wrote a splendid paper upon gas coal in the United States. I venture to say that not one out of ten happens to remember that, or would know where to find it; and in looking up the subject of coals from the standpoint of sulphur contained, or any other point, that information on hand and in print would be secreted and not brought to the fore to do us present good. The purpose of this index is to catalogue exactly those various past articles and make it easy for the members to turn to their box on top of their desk and find a complete set of reference cards to all the principal literature that has been printed. It has been estimated that each set will comprise about 6,000 cards, spread over three years, that the subscribers to this work will each ninety days receive 500 cards of a character like these samples, which I will distribute to you to illustrate the idea more clearly—that they will duly add those 500 cards to their set, and in looking up any subject will simply turn to their box, run through the tab index cards and simply pick out, it may be, for instance, on "station meters," perhaps twenty references, the foundations for meters, the construction and the design, or care of, or anything about meters. They will then turn to their files of the gas journals, and in the proper number get the information at hand. I think you can appreciate the benefit of having such a mass of information so easily at hand.

Now the Western Gas Association, naturally, having resources and income about the same as other Associations, is unable to pay the entire expense of such a matter out of its treasury fund, and it, therefore, has invited its members to subscribe to these sets, and has also broadened its doors so that the members of other Associations, although not members of the Western, can nevertheless subscribe to this index of gas literature. It believes that the more subscriptions that are received the better will the work be done, the more thorough, the larger the index will be that is received. It has been asked me, as one of the committee in charge of that matter, to bring it before your attention, so that those of you who are interested can get from me the information on that point.

Those who care to subscribe to it may send their communication to Mr. J. W. Dunbar, the Secretary of the Western Association, or to me, and commence to get the index the first of next May, when the first delivery will be made. I think a consideration of it will make you feel that it is a work of benefit to all the Associations, to all the members, to have this information in convenient, accessible form, and the cost of it, ranging according to the output of the gas companies, from $10 to $50 a year, based on a sliding scale, will put it within the reach of any of those who are earnestly and sincerely desirous of getting all the information on any particular topic that may be of moment or importance to them for the time being. This work—let me make it very clear—is purely a labor of love. The committee have no object or purpose other than simply to get this information in hand for the benefit of the gas people of the Western Association and their friends. These sample index cards are an illustration of the form of a station meter reference. They are under the heading of "station meters." The title of a paper is given, "Design and Construction of the Station Meter," the author, the date, the character of it, whether it is long or short, whether illustrated, whether detailed or general article, and all the journals in which it can be found. I think you will appreciate that any person having a block of 6,000 reference cards covering the past twenty years and all current literature, and covering one hundred or one hundred and fifty different *subjects* in the gas papers, with from twenty to one hundred references on each subject, would have all the practical references that he can use or that amount to anything. It is not expedient to go back more than twenty years into the dead wood of the past, or so far that few of us can avail ourselves of it.

On motion of Mr. Leach, seconded by Mr. McKay, a hearty vote of thanks was passed to Mr. Shelton for his clever and interesting explanation of the scheme and purpose of the card indexing system proposed by the Western Gas Association.

AN EXPRESSION OF SYMPATHY FOR CAPT. WHITE.

Mr. McGregor.—Mr. President, I think it very proper and becoming on the part of this Association to express our sympathy with Captain W. H. White in the loss of his estimable

wife. Captain White was always the first to come forward with comforting words for members in affliction. He was the first to see that the families were provided with resolutions. I move you, therefore, that the Secretary and Mr. McKay be named a committee of two to express to Captain White our appreciation of the great loss that he has sustained.

The motion was adopted by rising vote.

ROLL CALL.

ACTIVE.

Addicks W. R.	Boston, Mass.
Africa, W. G.	Manchester, N. H.
Alden, G. A.	Watertown, Mass.
Allen, B. J.	Allston, Mass.
Allyn, H. A.	East Cambridge, Mass.
Anderson, W.	East Boston, Mass.
Barnum, D. D.	Worcester, Mass.
Bartlett, L.	Cottage City, Mass.
Burritt, D. F.	Rockville, Conn.
Bush, R. W.	Brooklyn, N. Y.
Coffin, J. A.	Gloucester, Mass.
Coggeshall, H. F.	Fitchburg, Mass.
Cooper, A. F.	Exeter, N. H.
Cowperthwaite, G. E.	Danbury, Conn
Coyle, P	Charlestown, Mass.
Crafts, H. C.	Northampton, Mass.
Dickens, J.	Newburyport, Mass.
Dickerson, A. T.	Rockville, Conn.
Erhard, T.	East Cambridge, Mass.
Fowler, S. J.	Charlestown, Mass.
Gifford, N. W.	New Bedford, Mass.
Gillette, S. E.	Danvers, Mass.
Gould, J. A.	Boston, Mass.
Goulding, N. O	Natick, Mass.
Harbison, J. P.	Hartford, Conn.
Hassett, E. J.	Beverly, Mass.
Hintze, T. H.	Lowell, Mass.
Humphreys, C. J. R.	Lawrence, Mass.
Humphreys, J. J., Jr.	Worcester, Mass.
Jenks, Z. M.	Woonsocket, R. I.
Jennings, F. W	South Framingham, Mass.
Kelley, H. H.	Waltham, Mass.

Lamson, C. D.	Worcester, Mass.
Leach, H. B.	Taunton, Mass.
Learned, E. C.	New Britain, Conn.
Learned, W. A.	Newton, Mass.
Learned, C. A.	Meriden, Conn.
Leonard, C. F.	Fall River, Mass.
Macomber, G. E.	Rockland, Me.
Macmun, G. F.	Marlboro, Mass.
Manchester, G. L.	Easthampton, Mass.
Mansfield, G. W.	Salem, Mass.
McGregor, W.	Pawtucket, R. I.
McKay, W. E.	Boston, Mass.
Mooney, E. B.	Brockton, Mass.
Morrison, H. K.	Concord, N. H.
Morse, C. W.	Amesbury, Mass.
Moynahan, J. F.	Stoneham, Mass.
Nettleton, C. H.	Derby, Conn.
Norton, H. A.	Boston, Mass.
Norton, W. F.	Nashua, N. H.
Norton, P. T.	Nashua, N. H.
Nute, J. E.	Fall River, Mass.
Nutting, C. H.	Chicopee, Mass.
Prichard, C. F.	Lynn, Mass.
Richardson, F. S.	North Adams, Mass.
Shelton, F. H.	Philadelphia, Pa.
Sherman, F. C.	New Haven, Conn.
Slater, A. B.	Providence, R. I.
Slater, A. B., Jr.	Providence, R. I.
Snow, W. H.	Holyoke, Mass.
Spaulding, C. F.	Waltham, Mass.
Spaulding, C. S.	Newburyport, Mass.
Spaulding, W. H.	
Spear, J. N.	Boston, Mass.
Stearns, W. M.	Waltham, Mass.
Stone, A. F.	Chelsea, Mass.
Tilton, D. D.	Newburyport, Mass.
Todd, J. R.	Revere, Mass.
Travis, F. M.	New Haven, Conn.
Walker, W. L.	Fitchburg, Mass.
White, C. E.	Wakefield, Mass.
Willard, A. T.	Greenfield, Mass.
Wood, W. A.	Boston, Mass.
Woodward, R.	Pittsfield, Mass.

ASSOCIATE.

Barnes, A. M.	Cambridge, Mass.
Brown, F. H.	Waltham, Mass.
Browne, A. P.	Boston, Mass.
Cheney, H. N.	Allston, Mass.
Coburn, C. M.	Chelsea, Mass.
Davis, F. J.	Waltham, Mass.
Dunbar, A.	Brookline, Mass.
Gardiner, W. H., Jr.	Boston, Mass.
Hinman, C. W.	Charlestown, Mass.
Holmes, R. E.	Winsted, Conn.
Humphreys, F. W.	New Haven, Conn.
Mace, F. W.	Lynn, Mass.
Macmun, G. F., Jr.	Pawtucket, R. I.
McKenney, W. A.	Boston, Mass.
Nichols, W. B.	Roxbury, Mass.
Norton, A. E.	Boston, Mass.
Scranton, G. H	Derby, Conn.
Thomas, F. W.	Boston, Mass.
Tufts, J. P.	Boston, Mass.
Waldo, J. A.	Boston, Mass.
Wardwell, W. R.	Boston, Mass.

READING THE PAPERS.

The President announced that the next business in order was the paper list, and called upon the Secretary, in the unavoidable absence of the author (Mr. George F. Goodnow, of Waukegan, Ills.) to read the following paper entitled

Distributing Artificial Gas at High Pressure in a Suburban Locality.

Previous to the year 1900 the idea of distributing artificial gas under pressure exceeding $\frac{1}{10}$ to $\frac{1}{5}$ of a pound had been worked out very little. At the June, 1899, meeting of the Western Gas Association, and at the February meeting, 1900, of your own Association, Mr. F. H. Shelton called the attention of the gas fraternity to this idea of transporting gas from one town to another at twenty pounds pressure, and in that way supplying holders and from these holders distributing gas in the ordinary way. Such holders being already in existence

furnished a ready means of demonstrating such a project, and a reference to his paper will show good reasons why such a method can be instituted. The idea has been developed further by Mr. Shelton, and several others, to distribute to distant centers of population, by use of a regulator, to reduce the pressure to ordinary burning pressure without the intervention of a holder, and still farther to run with high pressure service pipes into the premises of the consumer and reduce the pressure at this point with individual regulators to the pressure best adapted for burning. The last two are the methods which have been used by the North Shore Gas Company in the suburban district supplied by its pipes.

This territory begins about eighteen miles from the north city limits of Chicago, on the West Shore of Lake Michigan, and extends north about sixteen miles, comprising a chain of six towns; also the military reservation of Fort Sheridan. In 1898 a gas works of the ordinary type, with ordinary cast iron distributing mains, was built in Waukegan, and the plant is situated about half-way between the north and south lines of the lake shore. In August, 1900, the construction of a high pressure line, extending southward through this chain of towns, was set on foot, after inspecting two or three installations of this kind near Philadelphia, then in their first year of operation.

The aggregate population of these towns, according to the last census, is about 17,000, and some intervals occur between these towns of two or three miles, with only an occasional farmhouse along the country road through which it runs. The largest town is a manufacturing centre of some importance, while the other towns and villages are comprised of suburban residences of Chicago people, with only a few small stores and markets to supply their needs, so that in these towns the sale of gas is very largely confined to domestic purposes for fuel and light. The manufacturing plants in Waukegan are extensive establishments which are lighted by individual electric plants, so that the market for gas in this direction is limited.

The character of the soil is uniform throughout the greater part of this line, and consists of a yellow, sandy clay, extending as deep as the pipe is buried with a cover of three and one-half to four feet. The line is over fourteen miles long, exclusive of branches, and is constructed of four-inch "line" pipe, which is

about ten per cent. heavier than ordinary merchant pipe, with screw joints, recessed couplings and taper threads and valves of special construction; expansion joints were used at intervals, and bends instead of fittings were used to turn all angles. Two district regulators were installed in two centres of population, and the distribution pipes from these joints used were of the ordinary variety for low pressure gas, while in the other towns the consumer is supplied directly from the high pressure mains through their branches at the same pressure as the main line, and the pressure controlled by individual regulators before each meter or group of meters.

The discussion of the relative cost of distributing mains with low pressure under the ordinary practice, and high pressure to the extent we are using it, would be well worthy of being used as a subject for a separate paper, with details and careful estimates or, rather, figures of actual construction expense for carrying capacity and similar efficiency under the two methods. But in the large part of our territory the conclusion was quickly reached, as the cost of low pressure installation would be practically prohibitive, and could not be supplied at all under such conditions, while with the high pressure distribution a good territory could be developed at moderate cost. For instance a two-inch line was recently run, 3,000 feet in length, in a district containing large country residences with ample grounds and the houses far apart, but with the prospective average consumption very high. We do not expect more than six meters to be set on this branch, but considering our investment we expect it to be profitable, as similar lines the past season have shown satisfactory consumption. Services in this territory have been run from 200 to 700 feet in length, of $\frac{3}{4}$-line pipe, and it has been our practice to lay this size for all ordinary services. We do not consider it advisable to lay smaller pipe, although the carrying capacity would be ample; but for stiffness, durability and strength we use this size. The service connection is made with special fittings and especially devised tapping tools. A round-way cock is put in at the main, the gas shut off and the service laid and tested; a curb stop with box is put in to be used in case of fire or accident. Another service cock with small bore is put at the end of the service. This can be shut off in case of derangement of the regulator, and the small bore in the barrel would not allow an

excessive amount of gas to escape under large pressure, even if the pipes were broken beyond this point. The regulator is then connected; this is of the diaphragm type and easily reduces the pressure from 5, 10, 20 or 30 pounds, as the case may be, to $\frac{20}{10}$ water pressure; 200 or more now in use have demonstrated the reliability of the regulators. Between this point and the meter or meters, as one regulator may be used for a group of meters if necessary, is placed a seal filled with cold-test oil which communicates with the outer air. In case the regulator should become deranged the gas would blow outside, relieving any excessive pressure on the meters or house pipes. An automatic cut-off has also been devised which will shut off the service before the regulator, in case the pressure beyond the regulator becomes excessive, thus doing away with the seal and consequent loss of gas. Similar arrangements on a larger scale are used for district regulators and have been found efficient and reliable. Our district regulators are in duplicate, and can be changed almost instantly from one to the other in case of derangement or need of cleaning. It is, however, the conclusion of the writer that, in this kind of territory, if the work were to be done over again, in view of our one year's experience, all the pipes would be made high pressure and the regulation individual. Much cost of construction would have been saved and the efficiency and reliability not impaired.

Two drips have been put in within the first half mile, and almost the entire condensation is taken out at this point, simply by turning an ordinary stop and waste placed below the surface out of the reach of frost, and allowing the condensed water with some oily matter to blow out until the main is free. A number of test drips beyond these points have been made, but scarcely any condensed liquid has been found.

No holders have been built away from the works, and since the gas was turned on, February 11, 1900, the supply has not been discontinued, and during some very cold weather, in the past December and January, not a high pressure service has been stopped by frost, although such stoppages in our low pressure system in Waukegan have been numerous. However, between the two drips above mentioned, and about 1,000 feet from the gas works, this four-inch main passes over a stone culvert, with less than a foot of cover for about 100 feet, and thus

lies in frozen ground. A greater part of the condensed liquid passes through this portion and is blown out at the drip beyond.

In the first half of December a week of extreme cold weather occurred, and rather mild winter weather until the middle of January. During this time of four or five weeks this main was gradually accumulating ice, and finally became nearly choked with it about January 10, when trouble in pressure at the lower end became manifest. By tracing back with pressure guages this trouble was located before any serious stoppage in the supply occurred, and after thawing the ice and blowing the drip beyond no further difficulty has been experienced; and it does not appear that any such trouble will occur at any great distance from the works, because all the water appears to be condensed, and the gas is almost completely dry beyond these points, as demonstrated by the absence of frozen services. No special protection has been given to these services to guard against frost, and many are quite shallow in the ground and exposed at many points.

This experience has taught us that the first mile or so of line after compression must be thoroughly protected from frost, because this portion contains continually a comparatively large amount of condensed water vapor; therefore, such portion of the pipe should be covered deeper and protected with more care than any other part of the line.

Much has been said in regard to decrease in candle power occasioned by this compression throwing down the illuminants contained in the gas. No such diminution has been noted, as the ordinary flat flame burner looks to be as high in illuminating value fifteen miles away at the end of the high pressure system as it does in our office on the low pressure system. A test, crude perhaps, but still of some value, was made with Jones' photometers. Two of these were adjusted exactly alike, side-by-side, on the low pressure system, in Waukegan, and one of them was carried without disturbance to the end of the high pressure pipe line, fourteen miles away, and no change was observed in the indicated quality of the gas, and a series of readings, covering several days, shows very little difference in the two instruments. The gas made is about half coal and half water gas.

The uniformity of pressure is shown by daily cards from the Bristol guage, which seldom shows a variation greater than $\frac{2}{10}$ of an inch through the twenty-four hours. This uniformity of pressure shows marked results in the little damage and long life of mantles and absence of smoky mantles. This is a condition of things that we notice continually, having the two systems of distribution for a comparison.

The ability to use gas at a higher pressure for fuel by simply adjusting a governor has been found useful, and the efficiency of gas burned under eight or ten inches pressure has been demonstrated to be much greater per cubic foot than that burned under three inches pressure. Some experiments have also been made, where mantle burners directly on the high pressure show a wonderful increase in the brilliancy of the light, but no data can now be furnished as to the consumption of the gas.

The compression is secured by direct-acting, Rand steam compressors, the gas piston on the opposite end of the piston rod from the steam piston. These have been adapted from ordinary air compressors of this type. In our plant they are in duplicate, one is used in the morning and the other in the evening. At the present time we are running from about seven o'clock in the morning until twelve o'clock noon, and from four or five until twelve o'clock at night; about ten to fourteen hours a day. The elasticity of the gas in the mains, which contain 7,000 to 9,000 feet of gas, furnishes the supply during these intervals when the compressors are not running. From twelve o'clock, midnight, until five o'clock in the morning, the fall of the guages is only four or five pounds.

The subject of storing gas under pressure in tanks at intervals along the line was considered but abandoned, temporarily at least, and our year's experience has not shown the need of such storage. The cost of compression has been estimated to be about two cents per 1,000 cubic feet, but this could only be estimated as the steam was secured from the boiler in use for other purposes, and the attention necessary for these machines is very little. Compressors driven by gas instead of steam seem feasible to the writer, but investigation has not been complete enough yet to warrant a recommendation, and he has had no experience with their use.

The amount of gas which can be supplied through this line which we have built was the subject of a good deal of speculation and theorizing, and it was computed that 12,000 to 15,000 feet an hour was delivered at the terminus with a loss of twenty pounds pressure; that is, having an initial pressure of thirty pounds, this amount could be delivered at the other end at a pressure of ten pounds. The use of gas on the line has not, however, up to this time been large enough to demonstrate this or prove it false, but from 40,000 to 50,000 feet per day have been sold within the last two months off this line, and a decrease in pressure of not over three pounds has been shown at any hour of the day between the gas works and the terminal, fourteen miles away at Highland Park, and this difference occurred between six and eight o'clock in the evening; at other times the difference varied from nothing to two pounds, thereby demonstrating that this line has a capacity of much more than 100,000 cubic feet per day; and I venture to say that at the hour of greatest consumption the line could deliver 15,000 cubic feet per hour with an initial pressure of thirty pounds, because the elasticity of the gas in the line at a decreasing pressure would furnish an additional supply of 6,000 or 7,000 feet, but inasmuch as the supply is taken off at irregular intervals from the first mile to the last, the capacity would be even more than this, and I think a safe estimate would not be under 15,000 feet per hour.

In this territory, of much scattered population of about 7,000, we began setting meters about the first of April, and the first of January in that part 440 meters and 80 street lamps were being supplied from this line. Of this number 230 were controlled by two district regulators, and consequently do not differ from those supplied from ordinary gas mains, but as 210 are supplied direct from high pressure mains with individual regulators, thus we have an excellent means of forming an intelligent opinion about district and individual regulators; and as I stated the reasons why, we have concluded to make our extensions next year chiefly with small high pressure pipes and individual regulators. When I say that we expect to supply next year through branch lines two golf club houses, two groups of university and academy buildings, the barracks and quarters on a military reservation and one or two hotels, each of these distant from 1,000 to 3,000 feet from our present

mains, the utility of this method of distribution becomes apparent, and careful consideration of the cost of this construction leaves us in no doubt that such extensions will prove profitable. We expect to carry an ample supply of gas to these points through 2-inch and $1\frac{1}{4}$-inch pipes. The life of these pipes can only be estimated by the experience of natural gas companies and those artificial gas companies that have used wrought iron pipe for small mains and services, but all of these examples point to satisfactory longevity.

Electrolysis is a trouble that we expect to encounter, but at this time we can only conjecture the gravity of the situation. Whether it will be worse or better than with ordinary gas mains we will be more competent to judge another year than at this time.

Some of the street lights above mentioned are being operated from low pressure mains, controlled by district regulators, and have mantle burners which are working in a very satisfactory way. A part of the street lights are being controlled by small individual regulators, located in the bottom of the posts. We are also experimenting with some controlled by valves, but no regulator immediately under very small orifices supplying the Bunsen tubes of mantle burners. We think these burners will be successfully operated, and they certainly give a brilliant light.

Constant observation of this method of distribution leads to speculation regarding the field of operation and the use to which it may be put. Large cities and towns may be girdled with high pressure mains, and district regulators branched off to feed existing low pressure mains at points where the supply is inadequate, and much expense be saved in construction of large feed mains, and a much more even distribution may be maintained; also, extensive outlying holders can be dispensed with, or the necessity of building such be eliminated.

The reason does not appear why coke oven plants or other cheap methods of manufacture cannot be located near coal fields or near navigable waters, where cheap coal or oil may be secured and the product piped long distances under high pressure to centers of population.

The extent of compression has not yet been determined, and whether 30, 50 or 100 pounds is the limit only careful study

and experiment can demonstrate; but that 25 or 30 pounds will not commercially deteriorate the quality of the gas for lighting or heating purposes I feel confident. I hope to make determinations of this kind with the calorimeter and photometer in the near future; also, after higher compression, if possible.

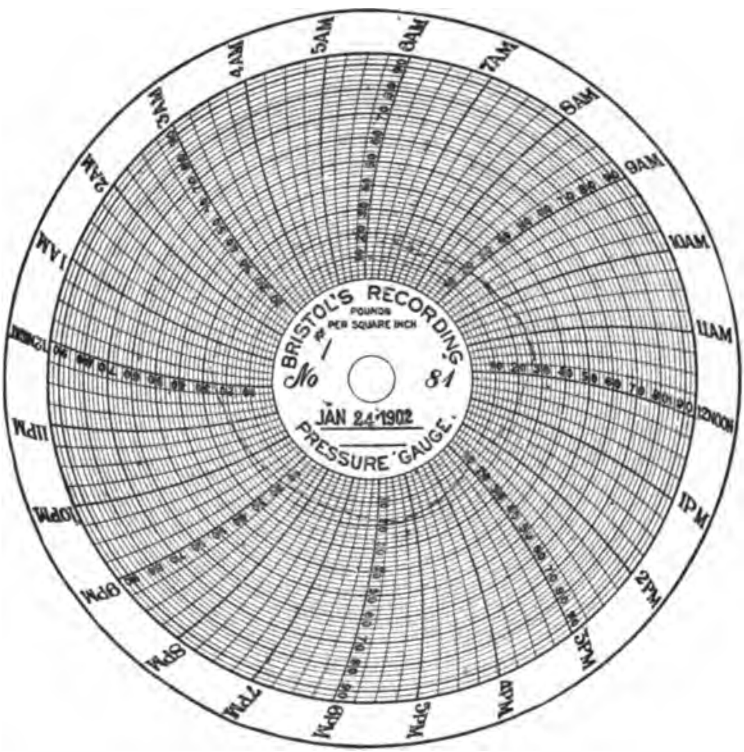


Chart No. 1.

In explanation of the table, the second column is the pressure in pounds as indicated on the Bristol guage near the compressor at the gas works opposite the hour named, while the third column is the pressure indicated by Bristol guage at the same hour at Highland Park, fourteen miles south.

January 14, 1902.

	Works:	Highland Park:
12 midnight,	24 pounds,	24 pounds
3 A. M.	24 "	24 "
9 "	16 "	14 "
12 M.	22 "	20 "
3 P. M.	22 "	22 "
6 "	15 "	12 "
7 "	15 "	12 "
8 "	16 "	14 "
9 "	17 "	16 "
10 "	19 "	18 "
11 "	20 "	20 "

The charts here illustrated show graphically as follows:

No. 1 is the pressure for 24 hours, January 24, in pounds at the gas works.

No. 2 shows pressure in pounds for the same hours on the same date at Highland Park. Our Bristol guage is situated just before a regulator.

Chart No. 3 is taken from a Bristol guage immediately after a district regulator, and shows the pressure in inches of water for the same 24 hours.

Photograph No. 1 shows a Rand compressor situated at the gas works, and fed by a separate outlet from the distributing holder. It has a nominal capacity of about 9,000 feet per hour, running 140 revolutions per minute. A duplicate of the machine is situated just at the right of this one. They are run alternately and both kept in perfect running order; in fact, since they were started about one year ago, each one has run for a time every day, and they are now running six or seven hours each per day, and neither of them has received any repairs beyond cleaning the poppet valves in the cylinder.

Photograph No 2 shows the regular equipment put before each gas meter, which has already been described, and shows five gas jets burning under a water pressure of $2\frac{1}{2}$ inches,

while the pressure before the regulator on a gauge not shown in the picture indicates 24 pounds.

Photograph No. 3 shows a gang of pipe men lowering a four-inch main into the trench prepared for it after the same has been coupled up on the bank and found tight under an air

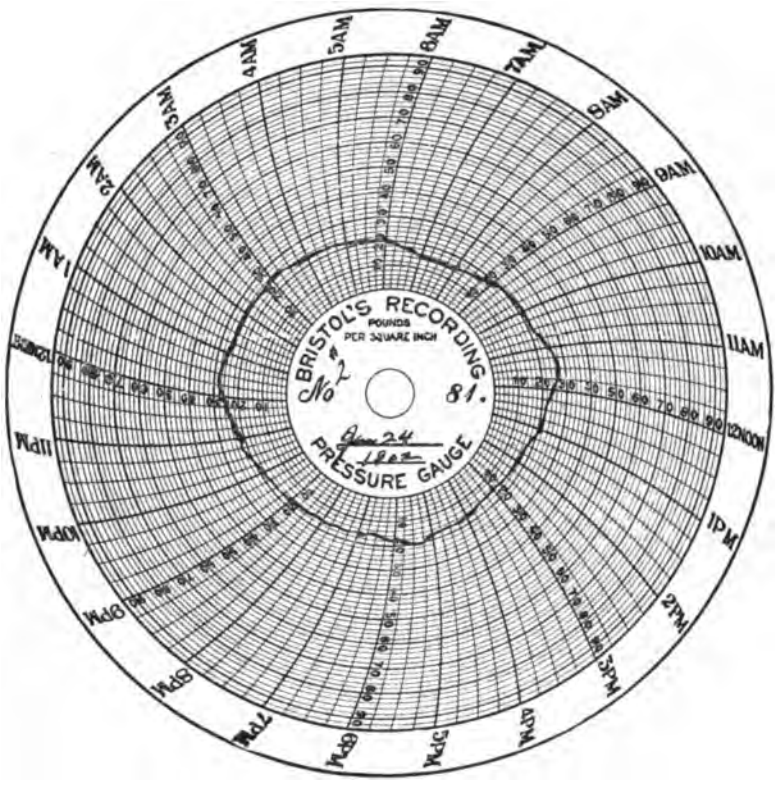


Chart No. 2.

pressure of sixty pounds, and the amount of pipe so put together and ready to be lowered may be 1000 feet or more, as it bends and can be handled very much like a long line of large hose.

Discussion

The President.—[illegible] gentlemen. We are [illegible] He [illegible] Association [illegible] make a few remarks upon this paper.

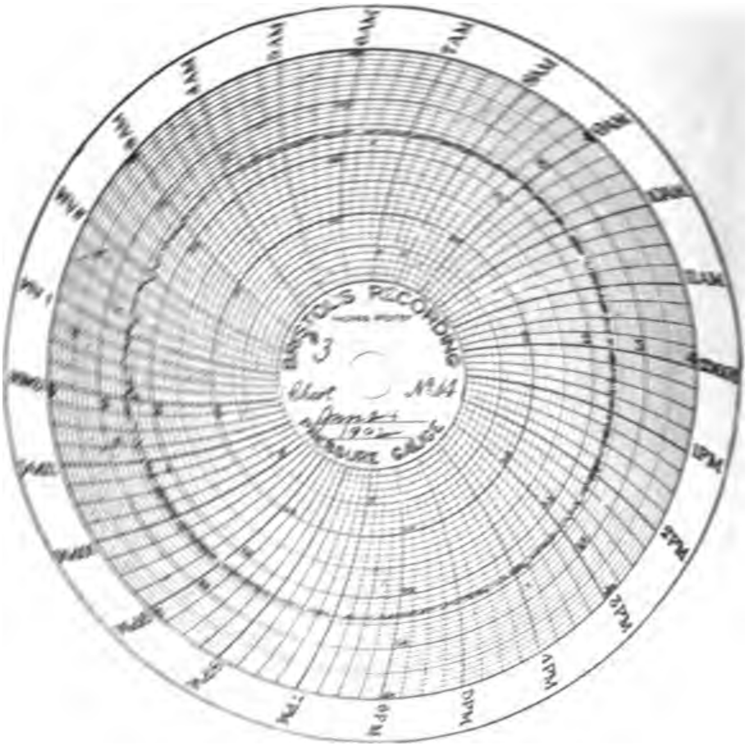
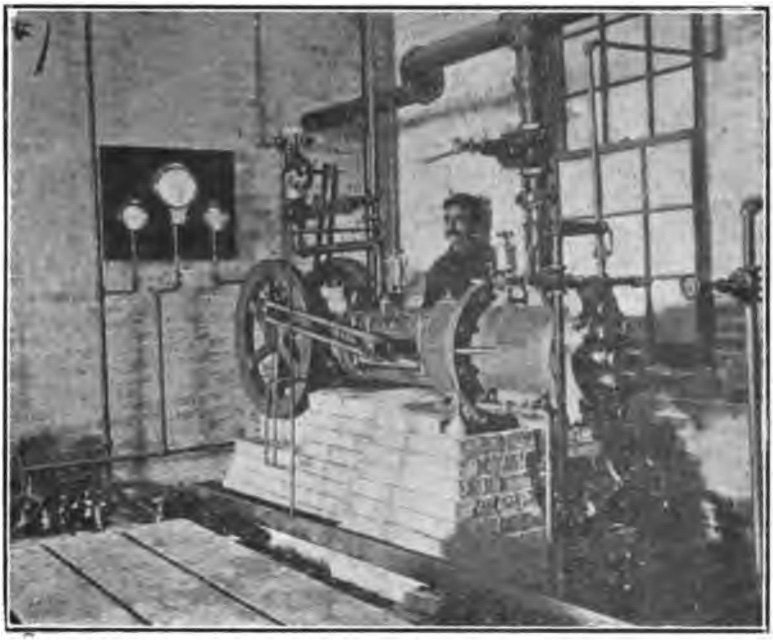


Chart No. 3.

Mr. Shelton.—Gentlemen, you can appreciate that it has been very pleasant indeed for me to find this paper brought forward. I have taken a good deal of personal interest in the success of distributing gas at high pressure on the lines that I advocated in theory three years ago, and had the opportunity to demonstrate two years ago, and which plan has been

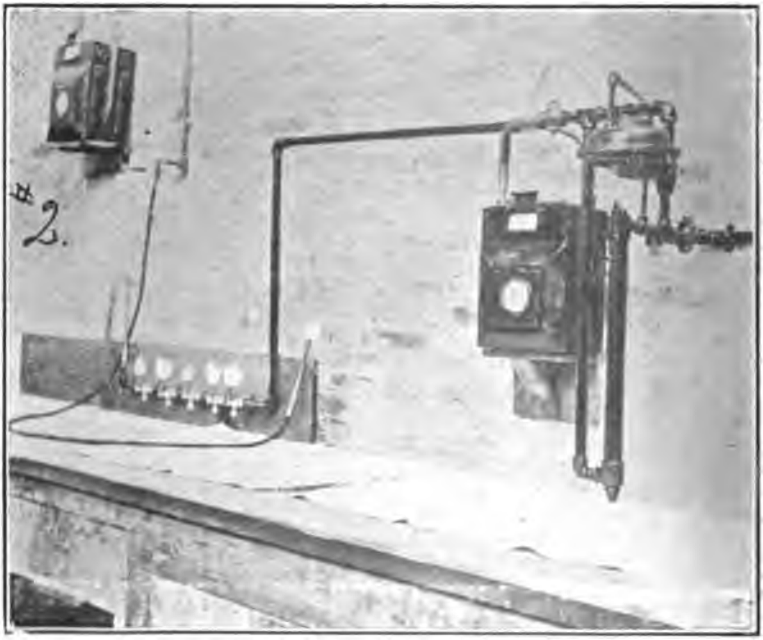
operating successfully since from the initial time of construction. I have had occasion to build several lines since that time, and they all have continued to work from the word "go" with entire satisfaction. The line built by Mr. Goodnow in Waukegan is one of the longest, in that it is fourteen miles long; and it is only four-inch pipe, working under twenty pounds pressure. It has not any gasholders on the outside;



Photograph No. 1.

it is dependent upon the behavior of machinery, the behavior of the regulators. I think you will agree he has given a most practical running description of it and of its details of operation. He has not stumbled across a thing, except a little freezing at the beginning of the line where it was inadequately covered, which I think is a very small discredit or trouble in operation, compared with the manifest entire success of the

long distance delivery which is shown in this paper. He has given us an easy, interesting, open, frank description of this novel installation in that section — the fourth or fifth of its kind in any section — and a description which completely bears out my belief in the beginning that such a line would work perfectly. It may interest you to know that high pressure, in the sense of distributing at 10, 15, 20 or 30 pounds, has



Photograph No. 2.

not only come and come to stay, but is growing and growing rapidly. There are nine lines in operation already. The original line built by me at Phœnixville, Pa., was two years ago in use. The next line, at Darby, near Philadelphia, eight miles long, now has 25 or 30 miles of high pressure pipe, feeding 1,000 or more customers — it is in a scattered suburban district, each with a house regulator perfectly doing the work. We don't have one in five hundred to trouble us.

The next line, three-inch, was built from Riverton, N. J., to push gas over to Moorestown, a small town of 3,500 people, four miles back, which never would have had gas if it had had to have its own works. The next line was to push gas from Riverton to Riverside, a small town of 2,500 people, where they picked up a few hundred people, who never would have had gas if it had not been for high pressure to get it to them.

Photograph No. 3.

The next line was built by one of your members, Carl Graf (long at Lawrence, Mass., and the last few years at Hackensack, N. J.,) who, by a line of six miles long, of five-inch connecting pipe, has been able to shut down an adjoining works at Rutherford, which the company purchased, and operate all their business from one station.

At Rockaway — within the limits of Greater New York — the Rockaway Beach works has connected up to the Far Rockaway plant, shut down one station and consolidated every-

thing at one point, at an investment of about $15,000 for connecting pipe line, etc. You can readily see that the interest charge on that line is far more than offset by the saving in consolidating the manufacture at one works.

Mr. Goodnow has described his Waukegan line of fourteen miles in length. There is another small line in Illinois, near DeKalb, taking gas from one town to another, the name of which I now forget. A new plant at Dover, N. J., under the direction of Capt. William Henry White, constructing engineer for the company, is arranging and has put in part of the equipment, to push gas to Rockaway and Port Oram, two adjoining towns.

I think you can see from this enumeration that high pressure is evidently doing the work of satisfactorily pushing gas from the point where it is made to the point where it is wanted. At least half a dozen other lines are under consideration of which I have knowledge, that will probably be built this summer, one of them to be thirty miles long. In other words, practice has proved that there is no logical reason why the theory of compressing gas to a number of pounds does not work beautifully, commercially, enabling you to cut down your expense in pipes enormously and yet get perfect satisfaction in your delivery.

There are four distinct ways in which you can apply this high pressure work:—

First, to couple up two works that the same interest may own and concentrate the manufacture in one station;

Second, for getting gas into some small town adjoining or near by, which otherwise could not afford to have its own gas works;

Third, for covering a suburban territory where the mileage is so great that to run a twelve or sixteen-inch backbone through a long, scattered district would be impossible or prohibitive from the financial standpoint; and

Fourth, the obvious application of high pressure to "boost" low pressure mains that are overtaxed.

An installation of that sort is under construction now in New Orleans, La. At that point there are some 200 odd miles of mains, starting with twenty, sixteen and twelve-inch

pipes from the works. There has been a tremendous lot of new business added there in the last eight months. The new mains are overtaxed. We have been confronted with the question of how to get the gas, that we can make readily at the works, to the point where we want it (one, two, three and four miles away from the works) throughout the city. The lowest estimates of cost for a twenty-four inch new trunk-line main exceeded $100,000 considerably.

I decided to put in a high pressure boosting system, eight miles in aggregate length, running to five different points in the town, starting from the works with six-inch, and running three miles thereof in one direction, with a couple of four-inch laterals to intermediate districts, and running two miles of six-inch in the other direction from the works, with one four-inch lateral, making five points around the city to which gas at high pressure is "short-circuited" or shunted from the works to where it is wanted and then put into the low pressure mains. That eight miles of pipe, laid bottle-tight, screw steel, coated and doubly coated (to make its longevity the utmost), and the pumping plant, the regulators —" the whole shooting match, if I may so express it — will cost us under $50,000. So that even with a cost of a cent or two for compression and pumping the gas, we still are ahead of the interest charges, and we don't have to find the money for the otherwise additional investment!

I think it is pretty evident from what I have said about these high pressure lines, which are matters that are getting to be more and more known in the gas community, that high pressure is a very useful plan for a great many things, and especially in the direction of relieving overtaxed mains. It is simply absurd, almost; the capacity of a little pipe working with gas at ten, or fifteen or twenty pounds pressure. One company operating that way has a run of $\frac{3}{4}$-inch pipe, 2,200 feet long. It feeds a factory that makes drugs, vaccine points and pharmaceutical specialties. They have been running overtime lately because of smallpox. (" 'Tis an ill wind that blows nobody any good.") They have been using twice as much gas as they ordinarily do. They have forty or fifty little glass blowing machines on which they work and draw the tubes in which the drugs are put up. They have no particular heating arrangements. They have forty or fifty girls working in a

large room, and on chilly days they heat by a lot of small stoves—gas heating radiators. We recently sold them a gas engine. We have kept piling on business after business until their bills, which started at $25 a month, now range between $100 and $200 a month, and they feel that we will wind up as proprietors of the drug factory, if we keep on. That little ¾-inch pipe, 2,200 feet long and over, is supplying the "whole shooting match"—again, if I may express it—and does not seem to be groaning a particle. We have been surprised. It knocks all theories and formulas sky high. If you figure the theoretical capacity of a small high pressure pipe and then double it you will find that you can do it. That is a very loose statement of my observation in the last two years in working with these convenient high pressure tubes.

In commenting upon three or four points of Mr. Goodnow's paper I only want to differ with him on his conclusion that all house services might best be covered by individual regulators. I don't think that that is proved, nor necessarily follows. A great deal is to be said on both sides. If you have a high pressure system throughout your city, town or suburban district, or whatever it may be, you undoubtedly have a magnificent advantage for getting high illumination by pressure. You can get six, eight, ten, twenty, or any number of inches pressure for incandescence of mantles, and on mantles six, eight and ten inches long, if you please to use them. You can get results in gas stoves that are superb. But you have manifestly 1,000 regulators to look after, to pay for, to attend to, *vs.* one district regulator. And a good many other points can be adduced on either side of the argument. I think it is a question of local condition whether one should use a district regulator, and cut down the gas to the ordinary low pressure practice, or put an individual regulator in each house. Notice particularly that Mr. Goodnow has no outlying holders of any sort; the only holders that he has are in his gas works. The gas is made and conveyed fourteen miles away and delivered all along the line, and he has not a holder in the place except at the starting point. The necessity of not having outlying holders has here again been absolutely demonstrated. Another advantage in this high pressure work is that you get a greater *uniformity* of pressure than under the ordinary conditions. The variation is only a tenth or two of pressure the twenty-

four hours around. You get less blackening of mantles and less irregularity in burners and stoves. You get a more uniform pressure at the house, which has been the ideal of the gas man to secure, but which is so difficult to get, with many customers of different sizes, burning at different times on a given set of pipes. High pressure almost eliminates the variation of local pressure. I think that the extent of pressure will remain within moderate limits; I mean ten, fifteen or twenty-five pounds. I think the experience of the Pintsch people in compressing city gas through two hundred pounds pressure for car storage shows that when you get into that range of pressures there is a distinct loss of candle power. We are doing pretty well as it is with three, four and six-inch pipes under twenty and twenty-five pounds pressure. We can get up to thirty, forty or fifty pounds, if necessity compels it in the future, and not have any great loss; but I think that the conditions will not necessitate for a very long time going beyond that, or that we need to consider or figure on other than the ten to twenty-five-pound range ordinarily followed.

Note that at Waukegan they have run their compressors perfectly throughout the year and have not had the slightest difficulty of any sort. I can say that unqualifiedly also, in the half dozen high pressure plants that I have been directly connected with, while we have put in duplicate compressing machines as a matter of precaution we have never had to fall back upon them. The repairs have been merely the cleaning of a little valve, and we can easily arrange to lay off for an hour or two once a month just to take it out and look at it, rub it up with an oil rag and make sure it is in good condition. We have had no repairs, no slips, no troubles with the machinery; none of the bugaboos that it was promised we would have, have materialized at all.

The President.—Have you made any experiments in the flow of gas in your high pressure pipe system, and also in regard to the loss in candle power?

Mr. Shelton.—We have made no experiments in the quantity of gas flowing through given size pipes; we have only observed the results after having gone ahead and put in our pipes. We figured, in the first place, as to the size of the pipes needed for a given capacity, by following in the main the practice of the

natural gas people. They have handled great quantities of gas through long stretches of wrought iron pipe. Their experience has been that of ten, fifteen or twenty years, now. Where they originally worked at ranges of 100, 200 and 500 pounds pressure they are nowadays working, especially in the cities, at ranges of a few pounds pressure, and they have worked out capacities in all ranges to a fair degree of standard. We felt it was sufficient for us to adopt the general pipe sizes which are in use in Indiana and in the Pennsylvania region for the handling of given quantities over given distances of natural gas, the gravity being about the same. Of course, the amount of gas delivered in any given case would depend directly and absolutely upon the length of the pipe, upon the pressure and upon the size. No one condition could be laid down to fit the next place. As far as the testing of candle power is concerned, we have not made any specific photometric tests. It has simply been a matter of chance; it has not been easy for us to have the apparatus, especially available at both ends of the line. We have been pretty busy on other things. We have found no difficulty on the candle power question, and we have perhaps been negligent in not exhausting that particular point and seeing just where we landed upon it. But I can only say, as I have said before, and as Mr. Goodnow says in this paper, that there is no visible difference in the candle power at the other end of the line. If the compression "knocks down" certain illuminants the gas seems to pick them up again!

On motion of Mr. Shelton a hearty vote of thanks was passed to Mr. Goodnow for his paper.

The President called upon Mr. C. S. Griswold, of Meriden, Conn., to read his paper on

HOUSE PIPING.

In the spring of 1899 we put in execution a plan we had for the piping of houses situated along the line of our main, in which gas had never been used for lighting. The introduction of gas stoves, with one light over the stove, has caused the people to inquire the cost of piping their houses, but in many instances the expense was so great it seemed to them exorbitant. These

houses were, in most cases, owned and occupied by mechanics, whose only income was their daily pay. After conferring with the local gas fitters, we established a price for both concealed and exposed piping, with fixtures and globes complete, ready to light, with stove connection (where one was not already in), for $11.00 and $15.00 respectively for four rooms, every additional room being $2.00 extra. We also gave a price without fixtures. We contracted with a local firm which manufactures gas fixtures, to supply what was needed. They designed one especially for us. We carry but two styles and prices of fixtures.

During that year we piped 128 houses, the local fitters doing most of the work, at $2.50 an opening, concealed piping. This was done without any canvassing other than the distribution of circulars and newspaper advertising.

At the close of the season the gas fitters thought there was not money enough in it for them, as the price of pipe had advanced. We therefore concluded to do our own piping, employing the men who had been setting stoves for that purpose. The plan of doing our own work gave better satisfaction, both to the consumer and to the company, more especially to the consumer, for in many instances one might wish a slight change from the original order, which can be made by the company at a nominal cost, and it more than pays, for it pleases a customer. In all cases trying to please a customer pays, for it brings new business and is a cheap way to advertise. To do this no large outlay is necessary, but careful attention to smaller details will usually accomplish it.

During the year 1900 we continued the same plan, but raised the price to $13.00 for our A grade, and $18.00 for our B grade of fixtures for four rooms. That year we piped 142 houses and also furnished quite a number of fixtures to houses already piped.

In 1901 we changed the style of fixtures, but only carried two styles and prices as before. For the year we have piped 109 houses.

The houses piped are usually from five to ten rooms. Only the very best black pipe is used and galvanized fittings. Our fitters are of the best, and some of them have been in our employ five years. Some who came to us as helpers, are the best

fitters we now have. They have been taught to think and work quickly, to use as little pipe and as few fittings as practicable, and have the work well done. In my experience as inspector of gas piping, I find that gas fitters, in general, use too much pipe and too many fittings. Another difference between our fitters and the regular plumbers is in the *use* of fittings. They use L's where they can, we use T's; for this reason, if there were changes to be made they could be accomplished more easily and much cheaper than when the line has to be cut to insert a T. Another advantage is, if from any cause there is a stoppage in the pipe you can more readily and with less expense remove the obstruction.

The sizes of pipe are mostly $\frac{3}{4}''$, $\frac{1}{2}''$, $\frac{3}{8}''$. Risers are never less than $\frac{3}{4}''$, stove lines $\frac{3}{4}''$, house runs usually $\frac{3}{4}''$, if not very long $\frac{1}{2}''$, never but one opening off $\frac{3}{8}''$. The reason galvanized fittings are used is because there is less liability for sand-holes than with black fittings.

The fitters must be courteous, quiet, quick and neat, quiet about the house, quick to think and work, and neat about their work. One who is used to piping will always try to get his riser so that he can extend from it with as few angles and as few cuts in the floor as possible. Of course some houses are harder to pipe than others. Those with double floors, or floors deadened with cement (our price is $3.00 extra for such) make a slight difference, but less than many would think. Gas pipe is small and takes up but little room.

Some people have said, "I should think the local plumbers would be down on you." Not necessarily; they could not get this work, or very little of it, for they cannot afford to do it as cheap as the gas company, and the gas company does not do any new work, so there is no conflict between us. We are on the best of terms.

The net loss per installation, when plumbers were doing the piping, was $6.00, but now that our men do the work and have become more experienced, the loss is practically nothing.

This year we expect to introduce a new plan. We will set a stove, with one light over it, as usual, and pipe (exposed piping) for two additional lights, either side bracket or single pendant, at an estimated cost to us of $15.00. To collect this amount we propose to set the slot meter at a sufficient advance

to enable us to get returns in five years, at which time the outfit belongs to the consumer. This will give us the opportunity of reaching a class of customers never before obtained.

Discussion.

The President—Gentlemen, Mr. Griswold's paper is before you for discussion.

Mr. Gould—I would like to ask Mr. Griswold if they ever lay a new main to supply a lot of houses which require piping in this manner, or if they simply take houses along their present mains.

Mr. Griswold—Houses that are to be piped, where such are along the mains, are always attended to, but to pipe a house at a short distance we should hardly lay a main.

Mr. J. A. Coffin—This is a practice that we have been engaged in some 20 odd years. We have done about 90 per cent. of the piping, both old and new, in house and fixture business, and have practically done it at cost, quite often at a loss. I think, taking the whole business, we have come out about whole. Perhaps we have made a few dollars on some houses under favorable conditions; but we never thought of setting the meter at an increased rate. I can readily see that it would add quite a lot of business, perhaps, to our present trading. People who pay from time to time would realize and pay for it. But we of Massachusetts have to conform to most all Boston ideas, and in Boston they don't allow galvanized fittings, for the same reason that this gentleman gives for using them—about the sand holes. The commissioners in Boston claim that as sand hole fittings can be galvanized so as to stop up the sand holes, and as such are not very durable, they don't allow any galvanized fitting to be used in Boston. About how much do you add per 1,000 feet of gas?

Mr. Griswold—13½ cents.

Mr. Anderson—One idea expressed I favor very much; that is, in relation to using T's instead of L's. It has been my experience that the use of L's has been a source of a great deal of trouble, for the very reason given by Mr. Griswold, and I have instructed my fitters for years not to use an L where

they could use a T; in fact, to use an L only in places where it was, owing to situation, useful to take out the plug.

Mr. F. W. Humphreys—Our experience at New Haven, being quite different from that at Meriden, may be of interest to some of the members. We started about September and did the thing entirely through the local plumbers. We piped the houses, four rooms for $15, and added $2 an opening for each opening thereafter. They charge us $2.50 an opening, four rooms $10, and the $5 additional covers the cost of fixtures and hanging. We piped up about 230 houses, and gave the people about three months' time in which to pay, taking payment at thirty, sixty and ninety days. Of course, the feeling between the plumbers and ourselves is very good. We did not have any trouble in starting the thing. We carried it along rather slowly for the first year, feeling our way somewhat; but as it stands today I think we will do double the business this coming season than we did last year. Our prices will be just a little higher. We are to adopt a different scheme. We will charge $2.50 an opening for the pipe and add the cost of the fixtures, giving the customers the choice of whatever fixtures they may want. If they want a very good fixtnre they can have it; if they want a cheap one they can have it; and there will be no complication in prices. Under the old way we carried two sets of fixtures and a few samples of other or better fixtures, and the trouble was that people would want a set of fixtures not the regular sort, which confused the prices, and we found that there were some few errors in the charges to the consumer. But with the method that we will adopt this year, of charging $2.50 an opening, and then adding the cost of whatever fixtures they pick, I think we have a very satisfactory arrangement, and that we will do probably just as much business at a slightly increased price. The indications are that we ought to do a good business this year. The canvassers did not devote their entire energy to that one thing, but worked it in with the stove placing. We will do the same this year, canvassing the stoves and the house piping together at the one time.

The President—How many companies do house piping? Let us have a show of hands. (Seventeen assented.) Mr. Coggeshall, do you pipe houses?

Mr. Coggeshall—We do. We are novices in it, having entered upon it this winter. We have been very successful. We employ the men that we had on stoves in the summer during the winter season for piping.

Mr. Nute—We have graduated from the condition of doing house piping ourselves, although we did it for quite a number of years, and got a large number of consumers in consequence of the practice. We are now to the point where we do not need to do it. I think we must have an unusually good set of gasfitters in our town, for they do it cheaper than we can ourselves. To show that they are doing some of it, I will say that they are piping about 1,000 old tenements a year in Fall River. They are doing it at a price of $2 an outlet where there are as many as four or five outlets on one riser; where there are six, eight or ten, they very frequently and very generally reduce that price somewhat. They are willing to give the canvassers hired by the gas company a commission of five per cent. on the business they bring to them of piping, in addition to doing this piping at these low figures.

Mr. Shelton—Does that include fixtures?

Mr. Nute—No fixtures.

Mr. Campbell—May I ask if that is not conducive to competition and poor work on the part of the plumbers? That is, don't they cut rates and make up for it by doing poor work?

Mr. Nute—I would like to say we get the very best work. All piping is inspected by the gas company, and is not passed until it is in accordance with our rules.

Mr. Scranton—Do you sell the fixtures, or do the plumbers?

Mr. Nute—The plumbers generally; we do not sell any.

Mr. Scranton—Do they sell them at the regular list price?

Mr. Nute—There is very sharp competition on the question of fixtures. The party who does the piping very frequently does not sell the fixtures.

The President—At this point I propose to present one of the questions in the question box that bears on this subject.

Mr. Allyn—Mr. President, before you do so I would like to move a vote of thanks to Mr. Griswold for his very practical and interesting paper. [Adopted.]

The President—It was not my intention to stifle the discussion, but I thought that this question in regard to pipe fitters might be brought up and discussed at the present time, so that if any of you other gentlemen have anything to say in regard to house piping you can do so later. The question is:

> "Has the licensing of gasfitters proved a benefit to the gas companies in Boston? And would the Boston companies recommend the passage of a state law requiring gasfitters to be licensed?"

Mr. Addicks, I think that is up to you.

Mr. Addicks—I am very glad to respond, Mr. President. I think on the whole the licensing of gas fitters has proved a benefit to Boston. To be sure there have been some hitches, as there always will be in any new departure of this kind; but I think on the whole that the people get better served than they ever did before, and that, without the friction as between them and the gas company, in that respect for the city authority is greater than that which the gas company will excite. Particularly is this true in relation to fixtures. They are now invariably put up in tight condition. They have to stand a pressure to which they were not subjected in the past — I am referring now to the test. The test for the house piping is similar to that which was used in the past by the gas company. I would say that the gas company inspects the piping in the same manner as it did before the city had anything to do with the testing, and on this theory that, even although work is passed by the city, it is perhaps wiser for the company to have its own inspectors observe the test as a protection to the company. There have been some objections, I think, in that the rules established by the department having charge of this, or the commission, if I may use that word, have been made without consulting the gas company in regard to the provisions that should be put in. So far as it relates to the construction of a building, that seems to me perfectly proper, but when it comes to providing that all gas piping used in the piping of the building must be extra heavy pipe seems somewhat unnecessary. Probably they must have heard of Mr. Shelton and his high pressure system, and thought it would require especially

strong pipe. However, that only lived in the specifications for a short length of time, but it was in print for that time. Again, they provided that the pipe should be inclosed in tar, to prevent corrosion under the floors. That was brought about by a practice in fireproof construction. I don't know whether it is being done in practice now or not, but in order to produce light floors the architects of Boston in order to have a minimum floor load got in the habit of using ashes with cement for forming the floor above the terra cotta arches. While I don't approve altogether of using ashes around pipes, we sold large quantities from the north end for that purpose—as long as they have to be sold I suppose we might as well sell them—but I pointed out that, if they were endeavoring to avoid corrosion and leak of gas in pipes by use of tar, a short circuit of electricity coming in contact with those pipes would produce gas from the exterior of the pipe being in contact with this tarry compound. We have so many illustrations of that in practice on the streets of Boston that it at once was apparent and was abandoned, not only for that reason but for others. On the whole, I think the inspection department has been a wise provision. I do not know that I would recommend it for a small town, as it might be unnecessary, but when you come to a very large city, and difficulties multiply in all directions, on the whole, I think it has proved beneficial, and I think if I were asked whether I should be in favor of continuing or abandoning it I should vote in favor of continuing it.

Mr Macmun—We adopted the house piping system some ten years ago, for various reasons. The first was that the plumbers' price for piping was so high that it barred the owners from calling for the work. Secondly, we found there was a small margin of profit in it for our company. Utilizing my spare time, I started house piping. Since that time we have piped about all the houses, have done all the gas piping in the city, and we find we derive quite a benefit from the practice, which you may see by our output today as compared with that of ten years ago.

Mr. Addicks—In connection with the house inspection the plumbers are licensed, but there is an especial provision in the law which provides that the company's employees are not required to be licensed. The licensed men have to take an examination, and I have required that our men before reaching

the highest grade of jobbers shall produce a fitter's license. I think it has made men study a little more and be a little more wideawake. I would also remark in connection with this law that no meter can be disconnected in the house of a consumer without its being done by an authorized agent of the gas company. That prevents the indiscriminate moving of meters for test by the various gas saving devices and testing devices that we have had in the past year, and is also quite useful in the competitive districts.

Mr. Anderson—I would like to ask Mr. Addicks his opinion in relation to the law given by the commission that meters shall have straightway valves at the inlets and outlets, or whether the old stopcock would not be the proper thing.

Mr. Addicks—Mr. Anderson has touched upon one of the points I raised, which is that these gentlemen have established rules without consulting the gas companies as to what they require. I don't know that I am fully prepared today to either advocate or oppose the use of valves as against the stopcock. One very grave objection, which caused the death of two men, I think, in Boston, is that when house piping is connected up with a stopcock in the usual way near the surface of the foundation wall, and that stopcock became defective, or leaky, or in a bad condition, or the head was broken off by the use of a wrench, that in replacing it with a valve of course it was necessary to take the valve stem out. When it was unscrewed from the body of the valve they either attempted to close the opening with waste or with soap, with the result that they had a large quantity of gas on, which ordinarily they would not have had with a stopcock, because the stopcock would turn in the space between the pipe and the walls without difficulty; I mean the stopcock with its stem in place and the stopcock closed. To obviate that, so far as our own company is concerned, which is doing work of that description, I have had made a cover for the valve, so that when the stem is taken out the cover will go in place, and to all outward appearance the valve looks like an ordinary horizontal side-swinging, check valve. After the valve is screwed in place the cover can be taken off, the valve plug remaining in place, and the stem can be put in place and the valve adjusted without having any gas on, no more than when the stopcock is used. So far as the use of the second valve on the meter is concerned, I think it is

utterly useless. The purpose of it I understood was the easy testing of the house pipe by putting a pressure on to the valve, but I think the chances are that the valves used by a great many gasfitters are inferior, and in order to test the pipes they have to put a plug in the end of the valve. Thus the valve is useless.

Mr. Anderson—Mr. President, the reason I asked that question was that we have had some little trouble with the valve system which has been put in. For instance, we had a notification of a leak a short time ago in a house where some Italians resided. I sent a man to look it up and he found that some person had turned one of the valves. The inlet to the meter had been removed, and the valve on the service pipe near the floor was turned on. They claimed it made them sick. Consequently they put in a claim to the company. Another valve placed near the entrance to the cellar was covered with coal, and that valve was turned on. When we dug down to get that main valve, to see why it was not shut off, we found the stem so badly bent that that also was leaking. And we found two or three cases where valve stems had been bent by coal being piled upon them. We have that sort of trouble. It is so easy for children to turn on stopcocks and cause leaks, etc., that we are held responsible for, that I think they should be removed and we should go back to the old system.

The President—I think I will read for your edification some of the building laws of the city of Boston:

> "There shall be a brass straightway valve on the service pipe close on the foundation wall, one at the inlet and one at the outlet side of each meter. Iron valves shall not be used.
>
> "Brass solder nipples shall be used on all meter connections.
>
> "Galvanized fittings are prohibited.
>
> "All service pipes in cold or damp places shall be painted with two coats of red lead and boiled oil."

Perhaps, as a matter of record, it might be well to read the house piping scale of the city of Boston. Instead of reading it,

though, I will hand it to the stenographer, and at the same time I will hand him the schedule or scale as used by the city of Hartford, Conn. Any further remarks?

The scale in use in Boston, referred to by the President, is as follows:

Iron Pipe	Length Allowed	No. Burners
3/8 inch	26 feet	3
1/2 "	30 "	6
3/4 "	50 "	20
1 "	70 "	35
1 1/4 "	100 "	60
1 1/2 "	150 "	100
2 "	200 "	200
2 1/2 "	300 "	300
3 "	450 "	450
3 1/2 "	500 "	600
4 "	600 "	750

Schedules of lengths and sizes of tubing with number of burners adopted by the Hartford City Gas light Company, to be followed by gas fitters in the piping of buildings for gas in the City of Hartford:

The schedule used in Hartford is as follows:

Size of Pipe	Length Allowed	No. Burners
1/2 inch	20 feet	6
3/4 "	30 "	15
1 "	50 "	20
1 1/4 "	75 "	40
1 1/2 "	120 "	60
2 "	160 "	100

Mr. Harbison—Mr. President, I would like to say a word regarding the Hartford scale. We are discussing here one of the practical questions in the supply of gas for illumination, domestic and manufacturing purposes, and I know of none more important, after the gas company has done its duty by furnishing at the meter a sufficient supply of good gas at a reasonable price, than that of the service beyond the meter, generally understood as house piping. As the brethren all know, as the price charged for gas is reduced its use becomes more general, and the piping put in years ago is found to be

very deficient, because of the scale, so-called, of sizes used. In every town and city supplied with gas throughout the country the experience has been that the consumption of gas has been gradually increased after the price has been reduced, its use becoming more general for all the uses to which gas can be put. This subject of house piping has been under discussion by the various associations of our industry at many times, and various associations have adopted "scales" for house piping. While generally agreeing with the advancement made by associations in this line, the Hartford company has singled itself out and made one step we think in advance of any action of any association on this line, and hence in 1900 we reaffirmed what had been sent out some years previous to the gasfitters of Hartford.

At this point permit me to say, Mr. President, that the gas company of Hartford has never done any house piping, and, notwithstanding the experience of our friends in Meriden, whom we greatly esteem for their progressive course, and others who do such piping, we have not thought it advisable to do it in Hartford. I may say in that connection, that with us the Plumbers' and Gasfitters' Union take care of that matter pretty generally. They have such a union, and no man can become a member of that union until he has passed an examination by a board selected by the union, who are experts, and shows that he is capable to do the kind of work required, and he has his license as having passed that expert examination. When he has done his work it is always compulsory that he shall have it inspected by a representative of the gas company, as to the size and lengths of pipe and proper construction of the work.

Now, sir, in 1900 we issued in a sort of advisory way to the gasfitters, a schedule of lengths and sizes of tubing, with numbers of burners, adopted not by the gasfitters, but by the Hartford City Gas Light Company, to be followed by gasfitters in the piping of buildings for gas in Hartford; and that not only means the city of Hartford, but the adjoining towns which the Hartford City Gas light Company supplies outside of the city limits. The card is in your hands. I will read it, and later on it will be published in the *American Gas Light Journal.*

Having read the card regulations, Mr. Harbison continued:

We sent one of these cards to every gasfitting house in Hartford, taking their receipt for it so that they could not say they had not the information necessary to get their job inspected.

I want to say in this connection, Mr. President, that the Hartford company has not in certainly fifteen years tapped anything smaller than a $1\frac{1}{4}$-inch hole in a gas main. We do not buy less than $1\frac{1}{4}$-inch pipe. We have taken up during the past half dozen years, when Hartford began to put down what is called improved, asphalt paved streets, a matter of several miles of three-inch pipe that was laid forty or fifty years ago, the works having been in operation since 1849, and we are using that pipe almost exclusively for service pipes—three-inch cast iron main. The trouble in our experience with permitting a $\frac{3}{8}$-inch pipe to be put in any room in any house, is that at certain seasons of the year, when the weather is cool, parties want to put in a radiator. They take off the bracket on the wall, put on the fittings, leave an outlet for the radiator, and want to put back the bracket, and there is not gas enough to supply both. If there was a $\frac{1}{2}$-inch pipe it would supply both. There is the difficulty which you will run against, gentlemen, all the time as the price of gas comes down. Our experience, perhaps, has been in advance of most of the members of this association, and because our selling price for gas has been much below the large majority of other gas companies, and our demand for gas has been in proportion to the reduced rate at which we are selling. That will be your experience. We have not found it necessary or thought it desirable to do any house piping. We hold the gasfitters or plumbers responsible for the way in which they do their work, and we do not care to interfere with them by doing the work ourselves. We require all new work to be inspected.

But, Mr. President, there is a pretty serious feature connected with our business, which I wish each one of you would take right home and think over; namely, that as you reduce your price of gas and it becomes more general in use, you find that people who want an extension of piping to parts of the building not heretofore piped get a gasfitter to come in and make it. We don't always get that job inspected, and there comes in a large element of danger by imperfect work and of possible responsibility to the gas company.

Now, we do not advise the people of Hartford to use gas as an invigorator to health or to inhale it with regularity, or anything of that kind, and yet occasionally somebody will do it. I have not known of a case in my limited experience where a party has undertaken to do that, either by leaving a burner open or by having an imperfect pipe or a fitting in these extensions, but it has been heard from afterwards. I don't believe that any of us are making a gas and sending it out to customers but that a certain quantity of it if properly inhaled will have a certain effect. We are not all free from that sort of thing. But it has been because of improper use of it, and it has come principally from those two causes, either leaving a burner turned on designedly to reduce a doctor's bill and making the result certain, or else imperfect work on the part of somebody who has extended a pipe without having it inspected. This house piping business is a very important matter. Plenty of men are capable of doing that work. If anybody wants fixtures and comes to us for advice—and there is no commission on this remark, and no chromo expected—we say to them that eighteen miles from Hartford, in the city of Meriden, is one of the finest fixture manufacturing companies in the country. We advise them to go there, and they will come and furnish them the fixtures. We don't want to interfere with the business. I agree entirely with our friend Mr. Addicks that a second valve by the meter is wholly unnecessary and should not be there. I agree with the suggestion that T's should be used instead of elbows, and that every means should be adopted and insisted upon by the managers of the gas companies, that every facility should be within easy reach of remedying any obstruction that may be in the pipe. We use only galvanized pipe for services, and I think that it pays to do it, as the slight difference in the cost of the pipe is many times made good by the lasting qualities of it in the ground.

Mr. Addicks.— I don't want to take the time of the Association in further discussion of this question, which has been pretty well threshed out, but as long as those two scales are to go in I think I would like to add a word. I am glad the gentleman read his scale. I was a little open in my mind as to what the other scale contained. I feared it might be smaller than the Boston standard, but I see it is larger. I should not like to be required to have all our services three-inch. I want

to call the gentleman's attention, however, to the fact that if he taps a $1\frac{1}{4}$-inch hole in all his main pipes his average main pipes must be larger than those of many other companies, as ordinarily I don't think he would tap a three-inch main, or possibly even a four-inch main, as much as $1\frac{1}{4}$-inch. But what I wanted to call to his particnlar attention was this: The difficulty in a large city today is the size of the present house pipe; that is to say, the present scale as shown in the requirements of the city inspection department. It is a copy of the old Boston scale, which has been used for years. The pipe is already too large to be used in a modern, tall building. Now, we have to think of that as well. I am glad the gentleman coupled with his explanation the fact that with his one-half-inch pipe it is intended to attach a radiator as well as a burner, indicating to a great extent the ordinary household use, and where possibly his pressure may be less than that of some other companies. We find that a $\frac{3}{8}$-inch pipe is quite large enough for the purposes he indicates. But when you come to the tall building, with the expanded metal partition, very thin partition, the question of a $\frac{1}{2}$-inch pipe or a $\frac{3}{8}$-inch pipe becomes an important thing, and we have lost many buildings simply from that reason alone. To be sure in the large apartment houses, where we lose the house lighting we make it up by having the stoves, because invariably in the latter building we put in risers for gas stoves. I only speak now because if no one else spoke it might appear as though the Association had carefully considered this question of pipe, and that $\frac{3}{8}$-inch pipe was too small to be used, and I would not like that impression to be left upon the record.

Mr. Harbison.—Mr. President, I simply want to say in reply to my friend that Boston is "the only." It appears that the surface here in proportion to the enumeration is very small, and hence they have to put up very thin partitions, in order not to knock the nap off their good clothes as they turn round in the room. But such conditions do not exist outside of Boston. We have room enough to breathe and to shake hands with our neighbors without putting our elbows out of joint. My experience has been that the continued increase in the use of gas demands a larger pipe to carry the quantity desired. In our three-inch mains we have no difficulty in tapping a $1\frac{1}{4}$-inch hole, and I think I have not within my recollection a single

case where the main has been injured by tapping a $1\frac{1}{4}$ inch hole. If there is a larger size to be put in we cut the main and put in a branch. But in a 4-inch we can connect a $1\frac{1}{2}$-inch, and in a 6-inch a 2-inch, and not hurt the main. We believe in a good, liberal supply. Our average pressure is a fraction over three inches, and because of the topographical situation in Hartford it is necessary to give a good supply, and because many years ago the house pipes were too small, much smaller than now permitted. But we find that it pays; it gives the people better satisfaction. They can get all they want and make no complaints. We are situated at the gas works so that we can furnish them all they need, and it is a mutual admiration society throughout. That is the practical working of it.

Mr. Addicks—Mr. President, if I am in order, I move that a committee of three be appointed to report to this Association a scale of house piping, and to include gas engines also. [Seconded by Mr. Harbison.]

The President—You have heard the motion, gentlemen. How will that committee be appointed, Mr. Addicks?

Mr. Addicks—I suggest that it be appointed by the Chair, and that the one who made the motion should not be upon the committee.

Mr. Harbison—I agree to everything but the latter remark, Mr. President. No restriction on the President's appointment. [The motion was adopted.]

Mr. John A. Coffin—Mr. President, I think Mr. Harbison's experience in tapping mains is in direct contrast to every other man's experience here present, so much so that, if not adopted by this meeting, there has been a general expression that $\frac{3}{4}$-inch was the limit for a 3-inch main, and 1-inch for a 4-inch main. We exceeded that limit till within five or ten years, tapping quite often a 3-inch main for an inch street L, a 4-inch main for $1\frac{1}{4}$ inch, and almost invariably with the most disastrous results. Broken mains, when frost was in the ground, getting out in the night and ventilating cellars, and barring for the leak to ventilate the break. My experience is only about half the general's. If one of our men was caught tapping a main above these limits I should call him down.

Mr. Anderson—I would say, Mr. President, I quite agree with Brother Coffin.

Mr. Harbison—Mr. President, there are ever so many men here who agree with Mr. Coffin.

Another Question.

The President—I am going to ask one more question, after which we will have the pleasure of listening to a short paper by Col. F. S. Richardson, of North Adams, Mass., which I believe is not on the regular list. The question is:

> "Can oxygen be made cheap enough to use in oxide purification?"

Who will answer it? Can anybody state how oxygen is made? If not, I will tell you. The air is freed of carbonic acid and moisture and forced through barium oxide in a steel retort under about fifteen pounds pressure, the retort being at a very dull, red heat. The oxygen is absorbed, the nitrogen and the balance of the air pass out through the retort by some kind of a safety valve. The retort is then heated up to a bright red heat and put under vacuum, and the oxygen is pumped out of the holder. The barium oxide is then cooled and used over again. As to the cost, I know nothing. Col. Richardson, we would be pleased to hear from you, and I say it was at my special request that Col. Richardson wrote this paper.

Col. Richardson—Gentlemen, the President's explanation alone is responsible for this paper. It has no merit at all other than my responding to his request. I was asked to write a short paper on the topic

WHAT IS A GAS COMPANY?

and this is the result:

Aside from the distribution of pure water for all domestic, manufacturing and municipal purposes, it is the most important factor in daily human life, and when we say gas company, let the term include and comprehend the combination plant, for as the purveyors of artificial light they are kindred. In my

judgment, and not so much for the benefit of the stockholders as for the good of the public, the law ought to be compulsory that gas and electric supply, in towns and cities under 100,000 inhabitants at least, should be from one, and only one corporation, and that company under State supervision.

It is, generally speaking, one of the largest local taxpayers. As such it is a reliable source of income to the town or city, and can always be depended upon as among the first to discharge this obligation. Who does not call to mind at this moment people in his own community who abuse and discredit the local lighting company, and who themselves try each year to evade payment of a poll tax and are never patrons of the company themselves? From such irresponsible sources do most of our unnecessary trials originate.

It is, or ought to be, one of the best customers of local merchants, upon whom they can all depend for full payment of their accounts when due. Would that we could have the same security in the receipt of our bills! It seems a prudent practice in which to indulge, that of buying always when possible of home people, even if costing a trifle more than in the wide market. It is a good investment.

It is usually through dividends paid, a safe source of income to many families, estates and institutions of charity, or learning. What more potent reason is needed for the local lighting company to freely publish, through the medium of local papers and otherwise, its progressive determination to give lower prices and improved service, and for the public to freely give its patronage, than the knowledge that large portions of its earnings are spent right at home for such deserving needs.

It is in many cases one of the best and most desired clients of banks. Did anyone ever know of a financial institution, or an individual for that matter, sustaining a money loss through legitimate business operations with a gas company honestly conducted? In this light our companies demand most distinguished consideration, and I make bold to assert that the securities of progressive artificial lighting companies, honestly and intelligently managed, properly and decently capitalized, protected as they should be from competition in their natural territories, and under just and rational supervision, must and will be classed as gilt-edged, taking their place with standard

railroad stocks and bonds, and rated only next below government, state and municipal bonds. I expect soon to see our securities accepted by various commonwealths as proper and desired investments for savings banks.

It is in furnishing street illumination, an agent under heavy moral obligation to the welfare, peace and security of every inhabitant of the territory lighted, and under equally heavy expense and risk. yet the agitation for municipal lighting, disregarding vested rights and investments, would lead the unthinking and uninformed and misinformed to believe that crisp, new bank bills of large denominations are a residual of Welsbach mantles, and that gold eagles are found in the inner globes of every arc lamp, at stated intervals of ninety or one hundred hours, whenever trimmed. But, alas! How different to us who know. Well maintained and properly distributed street illumination is an art, a positive protection to person and property, considered by all to greatly aid the police and by many to be more efficient. In some cases the latter view could be easily sustained.

It is the absolute custodian of more daily personal and household comforts than held by all remaining people or corporations in the community. If a disagreement with this statement is held, let the person realize his condition if deprived of the gas range, radiator, grate and Welsbach burner, or incandescent lights, electric sad iron, arc lamps and electric motors.

Our moral obligation to the hourly welfare of the city, its merchants and institutions, the wife and her household are not to be lightly considered. It is no holiday pastime to manage a local lighting company, and I would cheerfully contribute toward the expense of some political agitator, or an unreasonable faultfinder, or both, being compelled to assume for a year the trials, hard work and heartburnings of some faithful and successful superintendent of a public lighting plant. Some fallacies would be exploded and much criticism cease.

It gives an opportunity for sterling worth to be developed in young men; and who will say 'tis not a blessing to any community for boys to be given a chance, and for them to be led to positions of honor and influence. Our business is a profession. It is really an art. The more that is known of

the aims and purposes of the men controlling the artificial light business in various communities — that is, the most of them, for there are exceptions, and they are alone responsible for the odium attached to this industry — the more are they counted true and loyal friends of their city and state. It would truly be a misfortune were the public to lose the services and sustaining influence of its gas company.

Seriously, though, and lastly; it does open the door to honest, progressive men in managing artificial lighting properties to prevent suspicion surrounding the business, to gain the good will and confidence of the public — the greatest of all. It compels those in authority to keep their plants in a high degree of modern efficiency, their distribution equal to demands; their offices clean, commodious, well lighted and always open; their employees (all of them) neat, courteous, attentive and truthful; their complaints never neglected or disregarded; their service improved and their prices at the lowest point commensurate with proper operation, good return upon money invested, and a safe surplus for contingencies and disaster. Nor do I hesitate in declaring that where such practices prevail business will flourish, and the public will meet you heartily more than half way, saying — what is true — "Well done, good and faithful servant."

Mr. Addicks—Mr. President, I move a vote of thanks to Col. Richardson for his paper. I wish to cover also thanks for the fact that the President asked him to write a paper. [Seconded by Mr. Anderson and adopted.]

The President—I also personally thank you, Col. Richardson. I will make the following

Appointment of Committees on Obituary Resolutions.

On the death of Mr. F. C. Blood—Messrs. S. J. Fowler, J. J. Humphreys, Jr. and Z. M. Jenks.

On the death of Mr. D. W. Crafts—Messrs. H. F. Coggeshall, William H. Snow and F. S. Richardson.

On the death of Mr. George B. Neal—Messrs. F. C. Sherman, P. Coyle and H. B. Leach.

The meeting was declared adjourned until 2.30 P. M.

First Day, Feb. 19.— Afternoon Session.

The convention reassembled pursuant to the order for adjournment. The President introduced Mr. Thomas H. Hintze, of Lowell, Mass., who read the following paper on

A MODEL COAL SHED.

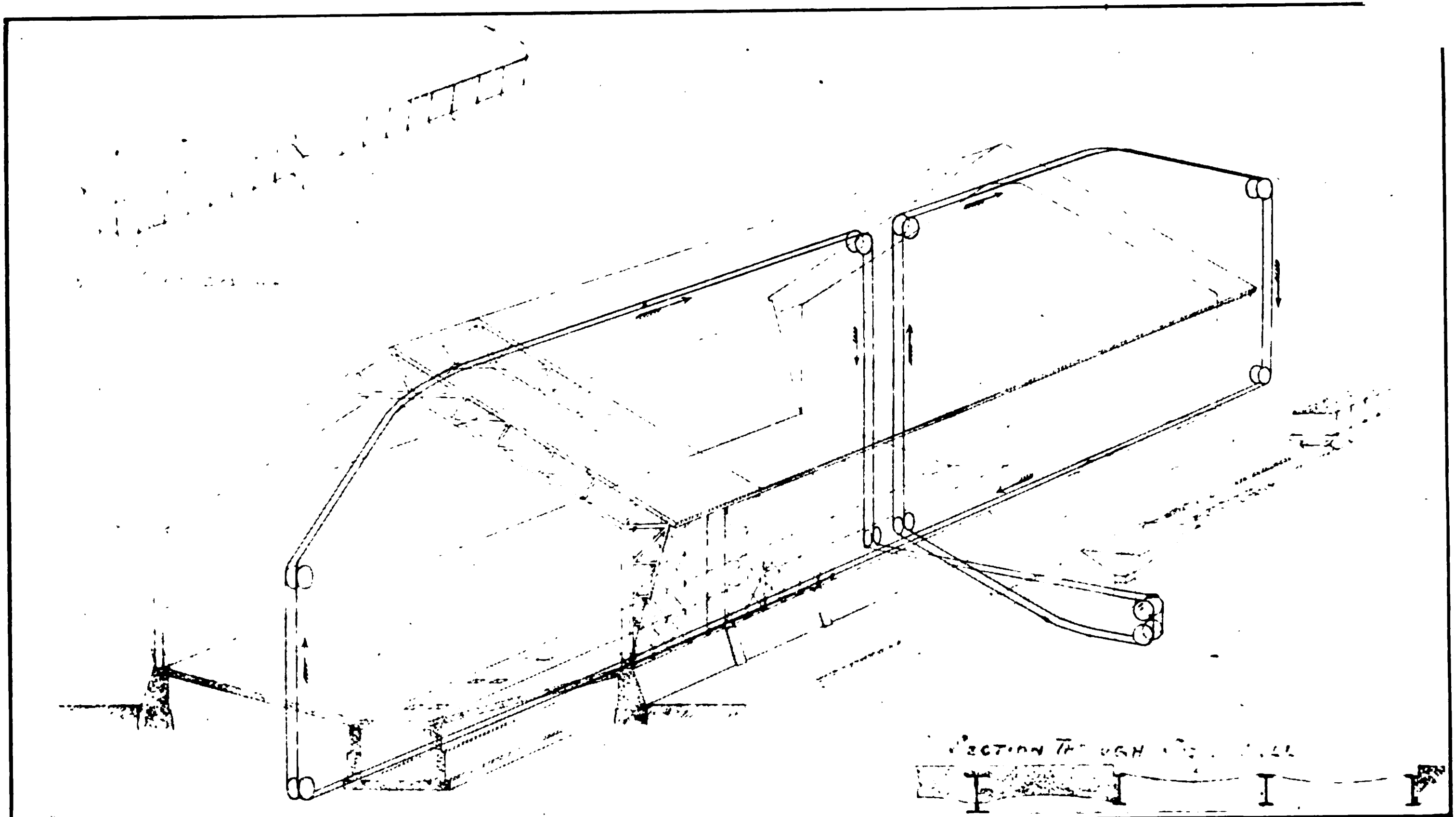
The original coal sheds of the Lowell Gas Light Company, consisting of two wooden frame buildings, 75 feet long and 50 feet wide, and built in 1849, are still standing and were used for coal storage until within a year. Today one serves as temporary quarters for a blacksmith shop, while the other is used as a storehouse for firebrick material and retorts.

Additions were made from time to time to the original building, as the business of the company increased, until the coal storage buildings covered an area 220 by 180 feet, and of a capacity of 12,000 tons, piled to the roof. The shed, or sheds, were low, flat roof, wood and stone buildings, and adapted to handle only short dump cars, such as were in vogue on railroads in the early days, and which are now rapidly disappearing from use in the coal carrying business.

Two sides of the question confronted the management in deliberating what was best to be done toward providing better facilities for handling and more storage room for coal. One was the necessity of adapting the shed to handle large cars, owing to the rapidly decreasing number of short cars available for use, and the policy of the railroad management to gradually drop from service the short dump cars, and the almost absolute necessity of greater storage capacity.

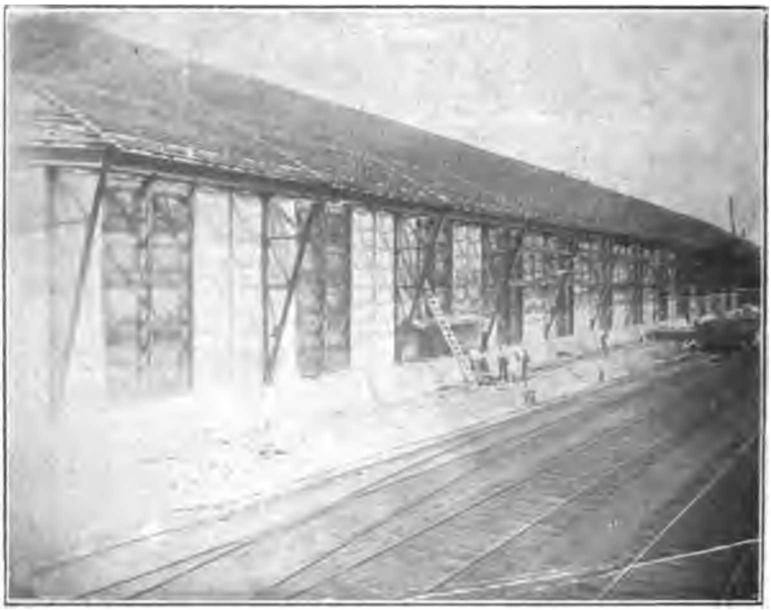
The matter of rebuilding was gone over thoroughly, and it was decided to begin with that end in view. As the subject was studied and time taken for further thought, it was finally decided to abandon the plan of rebuilding on the old site and to build an entire new structure for coal storage, in another part of the yard parallel with the railroad track.

The factor in deciding this change was that we would be better enabled to enlarge an overcrowded retort house and have more available room for general working.


SECTION

Operations were begun late in March, and the entire structure, including installation of machinery, was complete and coal was being put into the building by the following September.

Of the obstacles encountered in putting the foundation and subway for the building, I can only say that the entire system of underground pipes for water, tar, gas and ammonia liquor connected with the coal gas plant had to be changed, a 2,000-



barrel tar well abandoned and a thirty-inch city sewer, that ran at right angle through the yard, depressed some four feet.

I will endeavor, by the aid of the illustrations before you, to give a description of the structure. I think you will agree with me that it stands for all that is best in every sense of the word; an everlasting monument for the builders; a thing of beauty and a joy forever.

I will be pleased to answer all your questions in regard to the subject that I can, but do not ask me what the building cost, for that I do not know.

The ground plan of the shed measures 65 feet by 475 feet inside, concrete walls with hip ends. There are 18 main trusses, spaced 25 foot centers. These trusses are of the braced arch form. The top cord of each truss is made up of two 6 by 6 by $\frac{11}{16}$ steel angles, and the bottom cord of two 6 by 6 by $\frac{5}{8}$ angles. The diagonal braces of the top members will vary from 6 by 4 by $\frac{7}{16}$ to 3 by 3 by $\frac{5}{16}$ angles, and the

vertical members will vary from 3 by 3 by $\frac{7}{16}$ to 3 by $2\frac{1}{2}$ by $\frac{5}{16}$ angles. All gusset plates are of $\frac{3}{8}$ steel plate, weighing $3\frac{15}{16}$ pounds per square foot, and all rivets are of $\frac{3}{4}$ diameter.

The side portions of each arch are made up of 12-inch plate girder on the inside — that is, towards the building — and two 6 by 4 by $\frac{7}{16}$ steel angles on the outside, with angle members in between. These plate girders are made of four 5 by 3 by $\frac{5}{16}$ steel angles, with web plates $\frac{5}{16}$ thick. The sides of the building against which the coal is piled are made up of 12-inch by $31\frac{1}{2}$ pounds I-beams, spaced between arches,

and 5-foot centers with concrete walls arched in between. These 12-inch I-beams are supported at the top by a lattice girder of 8 feet, which is made up of four angles, 4 by 3 by $\frac{5}{16}$, with diagonal members of $3\frac{1}{2}$ by $2\frac{1}{2}$ by $\frac{5}{16}$ angles, and the vertical members of two $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{5}{16}$ angles. The roof will be composed of Ludorice tile placed on supports, without any wire connections.

The main purlins connecting the main trusses will be of 15-inch by 33-pound channels, spaced 6 feet 10 inches centers. Underneath the top chord of the braced arch, jack-rafters of 4-inch by $5\frac{1}{2}$-pound steel channels will be spaced 5-foot centers. The angles supporting the roof tile will be carried on these jack rafters. They are 2 by 2 by $\frac{1}{4}$-inch angles, and spaced 13-inch centers. Lateral rods of $\frac{7}{8}$ diameter round steel, with turnbuckles, are located in the roof trusses from this point across diagonally both ways — $\frac{7}{8}$ round steel rods.

The side walls of the building are 20 feet high, made up of concrete filled in between the supporting I-beams. The concrete entirely covers the beams on the interior of the shed, so that no metal of the structure comes in contact with the coal. The scales are placed as shown. I would say that this track which is parallel with the main track is also parallel with the shed, and is on a grade of one-half of one per cent. the entire length. There is room for 11 long cars, one placed on the scale. The scales are 38 feet long, and of a capacity of 80 tons. The car after being weighed is pushed on to the hopper, where, if it is a hopper-bottomed car, the coal is let out through the bottom, and if it is a sideboard car the coal has to be shovelled more or less. The coal entering the hopper, a cracker is placed right at the mouth of the hopper, operated by an engine as shown. The coal passes through the hopper and through the cracker into another hopper, and the chain of buckets on the conveyor is loaded to this point (indicating) and carried along in this direction right through, and coal can be carried to any point of the shed and dumped. That is to say, what they call trippers are located on this walk. In the peak of the shed there is a walk where this conveyor runs. In each bay is a section made of buckle plates, $\frac{3}{8}$ thick, and arranged so that in case of the firing of the coal on the inside of the shed these plates can be taken down from the outside and the coal gotten at very easily.

The driver that drives the conveyor is placed in the top of the shed, and driven by steam taken from the retort house just over *this* way. There are three shafts (not represented here) which are built of brick, surrounding the conveyor, one at each end and one in the center of the shed.

The foundation of the shed is carried to bed rock, and it is all concrete, measuring two feet thick at the top and four feet thick at four feet from the top, and that angle is carried down to the base wherever it may go. The slope of the bottom of the shed is 15° toward the center. In the arrangement for taking the coal out of the shed into the retort house there are valve holes sixteen feet apart, and the coal is drawn through those holes with a valve. The valve, of course, is accessible in the subway with a lever. A movable filler is pushed along at any of these openings where we desire to take the coal, and simply opening the valve allows the coal to run into the conveyor and it is taken outside.

Discussion.

Mr. Browne—I should like to ask if you can give me an idea of the cost per ton for unloading?

Mr. Hintze—I can give you the result of a 55-hour test, taken December 12: Total time of men employed, 55 hours; time lost placing cars and waiting for switching, 11 hours; actual time the conveyor was carrying coal, 42 hours; number of tons carried, 1,948; average tons per hour, total time, $35\frac{1}{2}$; average tons per hour, actual time, $46\frac{1}{3}$. The labor consisted of one engineer at 20 cents an hour, and one at $17\frac{1}{2}$ cents an hour; 1 laborer and four shovellers at 15 cents an hour; one foreman at 25 cents an hour. The cost per ton, total time — that is, including the time that we were delayed by switching — was 4.6 cents; cost per actual time, $3\frac{1}{2}$ cents; that is taking the coal out of the car, through the cracker and into the shed.

Mr. Allyn—I should like to inquire as to the form of conveyor employed; whether it is in the form of a scraper or buckets, or what?

The President—What system of conveyor have you?

Mr. Hintze—It is known as the gravity bucket conveyor, and each bucket holds 100 pounds of coal.

The President—Who are the manufacturers?

Mr. Hintze—It is the C. W. Hunt Company's system.

Mr. Allyn—Has Mr. Hintze any idea about how much horse power is exerted in moving this machinery up to its maximum capacity?

Mr. Hintze—The builders claim twelve-horse power. I take their word for it; I don't know anything different. We have made no test in that respect.

Mr. Sherman—Does all the coal pass through this cracker or crusher?

Mr. Hintze—Yes, sir.

Mr. Sherman—How fine does it reduce it?

Mr. Hintze—It is known as a six-inch cracker. No piece larger than six inches can go through without being broken.

The Secretary—I would like to ask whether this is a single or a double roll crusher?

Mr. Hintze—It is a double roll, made up of cast iron cylinders with pins, and they roll toward the center.

Mr. Browne—How is the coal conveyed to the retort house?

Mr. Hintze—At present we are operating the old retort house, and on the side of the building toward the latter is erected a wooden pocket for temporary use, the coal being spouted from this conveyor into this wooden pocket for a temporary affair. What is coming in the future in regard to that I could not say now.

The President—I presume you intend to put a conveyor from your coal shed to your new retort house?

Mr. Hintze—Yes, sir.

The President—One further question. Could you give us the proportion of concrete there, and then explain more particularly in regard to this tile and how it is fastened to the roof and the sides also?

Mr. Hintze—You mean the proportions of the concrete?

The President—Yes; that is, of sand and cement, or crushed stone, or whatever you have there.

Mr. Hintze—In excavating for this subway we got into considerable ledge. Being hard pressed to obtain gravel we hired a stone crusher and cracked our own stone on the job. It is made up of 1, 2 and 5.

Mr. Sherman—I would like to inquire if this coal comes by water to Boston or Salem, or whether it is all rail.

Mr. Hintze—It comes to Mystic Wharf by water, and rail from there to Lowell.

Mr. Sherman—It doesn't need a great deal of breaking up, then?

Mr. Hintze—We need a little breaking up on freight rates.

Mr. Allyn—I would like to ask Mr. Hintze if he knows of any other structure of this kind that has been covered with that description of tile, which is in use in this climate, and what its durability has been?

Mr. Hintze—There is no other structure in New England I know of covered with that tile. It is largely used in the West on all classes of buildings. It seems to be very durable and stands a pretty good shock without breaking.

Mr. Allyn—My reason for asking the question is that on one of the Harvard College buildings erected a few years ago the roof was covered with red tile, which I should judge was similar to that used in this structure, and it was found in actual practice that frost every winter would get under the tiles and break a good many of them, so that they slid down and endangered the lives of the students as they were passing in and out of the buildings. They were obliged to erect wire screens over all the entrances to the building to prevent the students from being "demolished."

Mr. Hintze—These tiles are not fastened to the rafters in any way, shape or manner; they are simply laid. Their own weight and their interlocking together keep them in position. I had in mind to bring one of the tile with me, but I came away hurriedly this morning and forgot it. The joints are broken, and they are simply laid on the rafters. One holds the other; they are, as it were, locked in together. It is a very simple and nice arrangement.

The President—I wonder if Mr. Carpenter would like to say anything regarding the construction of this coal shed.

Mr. Carpenter—Mr. President, I don't know that there is anything that I can say, excepting possibly as to the tile. The reason a great many tile have proven unsatisfactory is because they are fastened rigidly or cemented to the roof. The tiles

on this shed, as Mr. Hintze says, are free to move a limited amount in any direction, and yet it will take a good deal of force to get them out of position. They are very easily repaired in case any breakage does occur. You can work on the roof, knock the broken pieces out and get new tiles in. It is very convenient, indeed.

Mr. Prichard—Would Mr. Carpenter be willing to give us a general idea of about what this shed or a similar one would cost per ton capacity?

Mr. Carpenter—That would be quite a varying item, on account of the variation in price of steel; but just at present, and taking the average foundation item, I should say it would come within $4.

The President—Would Mr. Prichard be kind enough to state what his coal shed cost him per ton of coal?

Mr. Prichard—Yes, sir; $1.50. Of course, Mr. President, ours is a wooden shed, and it is just coal storage, without the machinery or subways or anything of that kind; simply a hard pine wood shed with a flat bottom. There is no comparison in the structure, of course.

Mr. Carpenter—I would call your attention to the fact that there is nothing about that shed to depreciate rapidly. All the steel sections are large, and any part that the coal comes in contact with is able to resist wear and tear. The depreciation has been reduced to a minimum.

The President—Mr. Sherman, we would like to hear from you. I believe you built quite an extensive coal shed at the New Haven works a few years ago.

Mr. Sherman—I have not the figures in my mind, but at the time we built it iron was down to dead, low water; I would say that we bought the iron work at $2\frac{3}{4}$ cents all erected, a price at which today you could not begin to buy the iron. We had no coal handling apparatus in connection with our shed, but at the time it competed with wood; it was about as cheap as we could build a wooden shed. In regard to this matter of tiling, Mr. A. B. Slater, Jr., who is here, I think could give us some points thereon. I have seen that work at the Providence company's south station.

The President—Mr. Slater is out at the present time. Any further remarks, gentlemen?

Mr. Hintze—Regarding this cracking of coal, a question was asked me, and I should like to get the opinion of the different members about the deterioration of coal; whether the deterioration is more by cracking or after the coal is cracked and stored, or cracking it according as you want to use it. Whether the coal would deteriorate more in a fine state than in a coarse state.

The President—Can anybody answer that question? What do you think, Mr. Addicks?

Mr. Addicks—Well, it is purely, Mr. President, "I think." I should think it would be apt to deteriorate more in a fine state than it would in a coarse state, but it is only a think.

Mr. Hintze—We have not had an opportunity to try the experiment, because we have not been able to keep coal in the shed long enough to show any signs of deterioration.

Mr. Addicks—I want to say, however, that I believe the important element is this: What is the deterioration of coal in the cracked state?—if I may use that expression—during the period in which you are going to store the coal before you use it in the retorts, as compared with the condition in a lump state. If it does not deteriorate materially in either case I don't think it makes any difference.

Mr. Wood—A point that should not be overlooked is that the modern conveying machinery is not adapted to handling coal in very large lumps. It has to be crushed before the conveying apparatus will take it.

The President—That point is probably well taken.

Mr. Hintze—The builders of the conveyor claimed that the machine would work equally as well with run of the mine or lump coal as with cracked coal. Of course it would necessitate a larger bucket.

Mr. A. P. Browne—Mr. President, if there is any gentleman present who has used both fine and screened coal from the same mine, he should be able to tell us whether the one deteriorates from exposure to the air more rapidly than the other.

The President—Anything further, gentlemen? A vote of thanks is extended to Mr. Hintze for his paper, the motion

having been made by Mr. Prichard and seconded by Mr. Richardson.

Mr. A. M. Barnes, of Cambridge, Mass., then read the following paper on

The Advantages of the Card System in Gas Ledgers.

When your President asked me to write a paper on this subject, he paid me a somewhat doubtful compliment by remarking that I was probably the only one in the fraternity who believed in the card system, implying thereby that the other treasurers and managers had not found sufficient merit in the system to justify them in adopting it. I can hardly "Lay the flattering unction to my soul" that I am more progressive than all the rest of you, even if I had the temerity to claim to be up to the average; but I will give you my ideas on the subject, based on nearly five years' trial of the card ledgers, and trust to the subsequent discussion to set me right, if I am wrong, in my opinion that the card system has many advantages which make it all-in-all the best system for gas ledgers.

I wish to preface my remarks with a short anecdote told by Ralph Waldo Emerson. One of his farmer neighbors came to him one day and asked him for the loan of some entertaining book, and Emerson, in a joking spirit, gave him a volume of Plato. The farmer kept the book some two or three weeks, and on returning it was asked by the philosopher how he liked it. "Well, Mr. Emerson," said he, "Mr. Plato is a pretty bright man; he's got a good many of *my* ideas in his book."

I presume many of you have recently received from the library bureau a little book, which, as Mr. Emerson's neighbor said of Plato's book, has "Got a good many of my ideas in it;" but I hope my points may possess the merit of novelty for some of you.

I suppose we are all agreed that the most important and most desirable feature in a gas ledger is that the consumer's accounts shall be arranged in regular sequence, to conform either with the routes by which the meter readings are taken, or with an alphabetical arrangement of streets and consecutive house numbers on each street. Each is possible with the card

ledger, but since we use the latter arrangement in Cambridge, I shall try to explain that one.

We have upwards of 14,000 meters in use, and for convenience we subdivide our territory into certain groups of adjacent streets; using the larger thoroughfares for the dividing lines or boundaries of the various groups, and carrying the consumers in each group in separate ledgers, which we designate as ledger A, ledger B, etc.

In each ledger the various streets in that district are arranged in alphabetical order by means of guide cards: Thus Acacia street is designated as A 1, Agassiz street as A 2, Appian Way as A 3; and each guide card bears the name of the street and its distinguishing number.

The consumers on each street are arranged on cards according to their house numbers, with a separate card for each consumer, and the house number is so placed on a little tab projecting above top of the card that it can easily be seen when glancing through the ledger. The specimen ledger which I have with me here shows the system clearly.

Up to this point there is little difference between the general scheme for the arrangement of a card ledger and a book ledger, but in the actual labor of opening or starting anew the two ledgers, there is a decided advantage in favor of the card ledger in any office that uses the addressograph (and most up-to-date offices of any size do have that labor-saving device, if no other), because with the addressograph the consumers' names and house numbers can be printed at the top of the cards at the rate of 400 per hour, whereas, on the book ledger, this work must be done by hand, at the rate of not over 60 or 70 per hour, with the added risk of a clerical error against the mechanical accuracy of the addressograph.

Assuming that we now have the ledgers started and ready for use, let us proceed with our comparisons. My largest ledger numbers some 2,000 live accounts, on cards measuring six and one-fourth inches by five inches, which are ruled on both sides with spaces sufficient to carry monthly bills for four years, two years on each side of the card, and the entire outfit is contained in two drawers, each measuring sixteen inches by six and three-fourths inches by five and one-half inches, and occupying together about 1,200 cubic inches of space in the safe.

At the end of two years, we simply turn the card over and transfer the consumer's name, meter number and other details from one side to the other, using the addressograph as before for the name and address. Just ask your stationer for the cubic contents of a book ledger which will give you the same accommodations for the same length of time.

All of you, I trust, are doing everything in your power to increase your business, and you must lay out your new book ledger with that increase in mind, leaving blank spaces here and there. Generally speaking, as time goes on you are apt to find that you have left a space "there" when you need it "here."

I may perhaps be absolved from any apparent egotism if I cite the growth of my own company as an illustration of the point I wish to make. I am now on the third year of my present card ledger. On January 1, 1900, when I opened the ledger we had 12,300 meters in use, and on January 1, 1902, the number had risen to 14,400. Part of this increase has been due to new buildings in streets already on our books in 1900, part of it to the opening of entirely new streets through land heretofore undeveloped, and part of it to the erection of large apartment houses where single houses had previously stood. I have in mind one apartment house in particular containing twenty-four suites, where three years ago only one consumer lived — let me say also, by the way, that each of these twenty-four apartments contains a gas range. What book ledger could be so laid out as to provide for such a growth as this, and yet retain the desired sequence of streets and street numbers? I would also say that I came across yesterday a street in one of our ledgers that had been opened since I began the ledger in 1900. It is an entirely new street, but we now have fifty-five consumers on it. The advantage of having that street in its proper place, and each consumer in his proper place, is, I think, evident to you all.

In my card ledger it has been necessary only to insert new guide cards for the new streets and new ledger cards for the new customers, and today my ledger, with its 2,100 additional accounts has the same system of streets in alphabetical order and consumers in the order of their street number that it had two years ago.

We use a similar system of cards with space for monthly readings for four years for our meter reading. The meter cards for each street are tied together, are kept in boxes in the safe, and are easily sorted into routes when the time comes to rea the meters. These meter cards can be added to indefinitel y the same as the ledger cards, to keep pace with the growth of the business.

I will next consider the advantages in the actual use of the card system in the routine of the office work. In our office we find it necessary to begin the reading of the meters on the 22d or 23d of each month, in order to get our bills out on the first day of the succeeding month, and we begin printing the bills on the addressograph on the 20th or 21st. As fast as the bills are printed we distribute them among the clerks, with the corresponding ledger cards, in order that the previous meter reading may be copied, and in this way we can pretty nearly keep up with the addressograph, but with the book ledger only one clerk could copy states from the ledger at one and the same time.

In making out and entering the bills there is the same advantage. When that part of our territory covered, for example, by ledger A (which numbers some 1,800 consumers) has been gone over by the meter readers and the meter cards have been turned in at the office, it is possible with the card ledger to divide the 1,800 cards among as many clerks as are available, and the work of making out and entering bills on that ledger can be completed before the meter cards belonging to the next district are turned in; but with the book ledger the bills must all be entered by one clerk.

The same holds good for all the ledger work. In posting cash our method is as follows: Our gas bill coupons bear initials and figures, designating the ledger to which they belong, and also the street and street number. Thus the coupon of the bill rendered Mr. Allyn, who lives at 471 Broadway, is marked by the addressograph, B., B4, 471, and Mr. Fowler's, who, by the way, knows a good thing when he sees it, and has taken up his residence on one of the toniest streets in our territory, is marked C., S2, 2. These coupons are entered day by day, on loose cash sheets in groups, according to their ledger initials, the "A" coupons in one group, the "B" coupons in another, and so on.

On our busiest days these coupons will fill forty to fifty pages of the cash sheets, and we can use our entire office force in posting, by giving each clerk a cash ledger and passing the cash sheets from one clerk to another as fast as he or she has posted the items belonging to his or her ledger. We find this expedites the posting very much, and the same method of dividing the ledgers among the clerks enables us to take off our unpaid bills and balance our ledgers in a very short time. This division of work is not possible with the book ledgers.

In this connection I would like to cite our experience of the present month. On the fifteenth of the month, which is our last day of discount, bills were paid at the main office and at our agencies by 4,716 consumers. All that work has been posted by what was equivalent to 76 hours of one clerk. This division of work is not possible with a book ledger. Perhaps I ought to say that that work was divided as follows:

We started in on Monday morning with four clerks posting. Those four clerks worked twelve hours — not the same day. Two clerks were put on an additional ledger in the day, and the total number of hours of those clerks was eight hours each. Two more were put on still later in the day, and they worked six hours. So that at eleven o'clock yesterday all our posting had been completed, and they immediately began the work of taking off the unpaid bills, and all that was done before five o'clock last night. Of course the small number of unpaid bills made that work somewhat shorter.

Moreover, by this system of division of work the clerk becomes thoroughly familiar with all the varying details, and is competent to do whatever needs to be done at any time. They become useful in every department; need not wait for someone else to furnish his or her part of the work: and the office routine is not disarranged or materially delayed by the absence of one or more of the force.

Let us take up another point. I doubt if we in Cambridge enjoy any enviable distinction in this feature of the gas business, even if we do in some other, but we occasionally have a visit from an irate consumer who declares that her bills (it is usually one of the gentler sex) are "ever so much larger than they were a year ago." Think what a convenience and what a source of satisfaction it is to be able to bring out her ledger

card and convince her — well, perhaps not convince, but show her — that her statement is not borne out by the facts. A short time since I did convince a consumer in this way that she had been dilatory in her payments nine times during twelve months, although she claimed that she had always paid her bills promptly. You could not use a book ledger for such purposes with equal facility.

Suppose you wish to look up a consumer's account for any purpose whatever. In the book ledger you must turn over the leaves until you find his street and then follow along until you get his house number; or if the book ledger is kept by serial numbers, you must hunt more or less to find his number, but with the card ledger you have only to go to the drawer containing the ledger which covers the district in which he resides. The guide card gives you his street and the tab at the top of his card his street number, and you put your finger on it at once.

I have heard the card ledger objected to on the ground that a customer's account might get misplaced, or even be feloniously abstracted. The latter objection seems rather trivial, and, under the plan in vogue in our office, implies collusion between several clerks; but this danger might be avoided, if desired, by locking the cards in the drawer by means of a rod passed through the bottom of the drawer. I may say that we have had the card ledger in use there six years, and so far as I know no card has ever been permanently lost. I have known of a few rare cases where a card had been misplaced, but it was easily found again by looking over the tabs which project above the top of the cards and bear the various street numbers, as any irregularity in their sequence would show at a glance.

To sum the whole matter up, I claim for the card ledger the following advantages:

1. *Accessibility.*—It is always easy to get at. There is nothing buried or lost, and it is handy for use with customers.

2. *Divisibility.*—The ledger work can be divided among the entire office force, if desired.

3. *Expansion.*—It can be enlarged at will. It has really but one end, and that is the beginning.

4. *Order.* The accounts are at all times in their proper place and sequence.

5. *Economy.*—Of time and labor in making up consumers' accounts, copying states, entering bills, posting cash, taking off bills and transferring to new ledgers.

6. *Simplicity.*—It is easy to comprehend. There are no waste spaces, and it is free from the vexing problem of proper apportionment of space for future growth, so inseparable from the task of starting a new book ledger.

Discussion.

The President.—An interesting paper, gentlemen, as we expected. Now we are going to have a grand discussion, but before we do I want simply to get an expression. I wonder how many of the gas companies are using this ledger card system. Will they please signify by raising the hand? Eight; very good.

Mr. Barnes.—I would like to suggest that you include in the question what is known as the loose leaf ledger.

The President.—How many are using the loose sheet ledger? Three. How many are using the card system for taking meters? Eleven. How many are using it in their stock room? Four. The paper is open for discussion. Mr. Richardson, we really would like to hear from you.

Mr. Richardson.—Upon the request of the President, last night, when it was found that we use a system similar to this, I telephoned home and have just received the blanks that are used by the North Adams company, and the system is simple. I have never seen it duplicated, and it is wholly for our own convenience. Each department is kept separate and is indicated by various colors, entirely by that, and all our record is on the card system. It apparently is elaborate, but it is very simple in itself. I will explain the use as quickly and as clearly as possible, and will be happy to answer any question. Our bills are made in one form, the green color being used for the gas meter, and the yellow for the electric. They are identically the same size. They are each perforated with a coupon and a bill, and there is a convenient point for the statement to be taken. Prior to the statements of the meters

being read these bills are each filled out by having the folio page, the meter number, the number of the light, the address of the premises and the name of the customer, duplicating this somewhat on the coupon, and meter statement for last bill, so that at the end of the current month the bill is filled out complete for payment for the succeeding month, save the entry of the figures, which read "meter statement above." These are sorted then, both the gas and the electric bills successively, on each street, or on a route for each meter taker. In our case we have perhaps nine routes, so that if the men start at the foot of Main street, or any street, they go up one side and down the other or a more circuitous route. This makes a successive form in from perhaps 80 to 120 bills. The bills are put in a little cardboard pocket and held by the meter taker, so that they are protected entirely on the back, and in front up to the consumer's name. A meter taker starts at say No. 2 William street. This would plainly read as he goes on his route, "No. 2 William street; John Jones." It is held in a convenient way, and the meter is read by the statement being marked on the bill. As he goes out this is taken out and put in the rear of the pocket. The next bill reads, say, "4 William street." That is carried out through the entire system with eight or nine meter takers. The advantage of this is that directly these bills are returned from any one route they are complete entirely, except the necessity of reading, and any of the clerks can do that. Three figures, a subtraction, an extension and the bill is made ready for delivery. This is done by the same people after they are all made out, and as they are left each bill is detached and given to the customer, receipted or not, as the case may be, and the coupon is brought back and put in an alphabetical cabinet. If this bill is not paid when it is delivered it is requested to be brought to the office. It is presented at the window, and the coupon is taken from the alphabetical cabinet, and receipted; the discount, if it is paid, is shown, and put upon a peg, and from that the cash is made every day.

Now, the loose leaf ledger, the next step in our system, is in form, virtually the same as the card, except that it gives the complete record, and it is printed, two years on one side, then reversed for two years more.

Mr. Barnes.—Excuse me. That is no exception. No difference in our ledgers in that respect.

Mr. Richardson.—I mean to say it is printed so that the loose leaf ledger is always written upon the right hand side of the book, or, in other words, it is turned over, and you don't have to write upon the two sides of the ledger each time it is used, which is a very great convenience in the matter of 500 loose pages. When these bills are all made they are sorted alphabetically and entered upon a loose leaf, sales' book. That is kept separately on each month's account. That record in a year is complete, too, so that a customer's ledger, and every bill, is complete in the one ledger for four years. Every month is complete. The cash book is made from that book. That is the entire method used by us. It may not possess every advantage that the card catalogue does, but we extend the card catalogue in this shape. The record of each meter is kept on a card, and can be traced from the date when it was bought through all its transfers to its repair, or if it is condemned. A card of a different color shows each arc lamp, where it is placed, its number and its length of service. Another shows each transformer, its capacity, its number, and the number of customers. Each record of a test meter is kept in the same form on a different color. A deposit slip as a coupon book is kept in the same form, as is a "set" card, or a "take down" card, or a "statement," which is made in a coupon book in the same way. So that, these all being returned by the men doing the work, there is a complete index in a bound form for every operation of gas or electric, referring to a meter, transformer, arc lamp or a gas stove. In its principle it is exactly the same, only in different form to the card index.

Mr. Barnes.—Of course we extend the card system in our office to a great many other departments. My paper only referred to the gas ledger, so I only exemplified the use of the card system in the gas ledger. We have a system very much like Mr. Richardson's for other details of the work, and it can be extended to almost all the departments where any account of any kind or nature whatsoever is kept.

Mr. Woodward.—Does Mr. Barnes keep what we call a sundry sales' ledger — that is, sales of stoves, fittings, etc., and if he keeps that on the cards.

Mr. Barnes.—Yes. We have a regular ledger which is called the stove sales' ledger, and each sale made is entered on it, that is, every sale where an appliance is charged. Of course if it is a cash sale it does not go on to that ledger. On one side of the card ledger the consumer's account is written, whether he has a range, or a heater, or a radiator, or a stove or anything of that kind. On the card on which we keep his running account for gas consumed, if he owns a range we note a range, if he owns a stove we note a stove, if he owns a heater we note that, or if he has got a hot water heater we note that; that is, it is noted on one side. So, if a consumer comes in and expresses surprise at the extent of his bill, there is possibly one solution for it at hand immediately. "You have a gas range; haven't you?" "Yes, we have." But I thought the gentleman asked about keeping the debit and credit sales of the gas stove business. Wherever a gas appliance of any kind is sold and charged it is entered on what we call our stove sales' ledger.

Mr. Woodward—Our company has for a number of years kept a loose leaf ledger, something like Col. Richardson's, and now the question comes up about keeping these sundry sales. I think Mr. Barnes's paper is most valuable. It shows the merits, perhaps, of the card system over the loose leaf ledger. I might say that we expect soon to put into operation a card system to keep the account of those sundry sales. We sell a large amount of Welsbach goods, mantles and chimneys—little sales, which are charged up one month and soon paid; and it seems as if we can handle it a little more readily with the card system than we can with a loose leaf ledger. A card is easier to write on, and the card is far more easily taken out and filed among the tranfer list than is a sheet from the loose leaf ledger. I do like, however, a loose leaf ledger for the gas account proper.

Mr. Barnes.—I think the gentleman would find it of very great advantage. We have a system of sales' slips. Each sale made and charged is made on a numbered sales' slip, and the purchaser's card in the stove sales' ledger bears the same number in addition to the man's name as the sale. Suppose you want to look at a man's account. Of course we have an index to the ledger kept on cards as well; a card directory. If Mr.

Frank E. Sands has bought a stove, we look him up in our card directory and find that the number of his sale was 2,276. We can either look at the sale note or we can look at his ledger card and see any particular that we wish to find out about it.

Mr. Macmun—I would like to ask Mr. Barnes what method he uses to obtain his total gross sales.

Mr. Barnes—In obtaining the gross sales of what we call the bills rendered each month — I suppose that would be the same thing—we have (I hope a good many of you have it. and if you don't you ought to have it) what is known as a registering accountant. It is a machine which will print figures up as high as nine millions. You can use it for adding or for any purpose. It records and adds at the same time. We have a long sheet of paper that will hold possibly forty-five different consumers. We start with the beginning of the ledger—by-the-way, this will hold a sheet any length you want, and it is about twelve inches wide, so that we can take in six columns on it—on we will say forty-five cards. The clerk takes off on that registering accountant the first man, 5,800 feet, turns his card down; second man, 4,800 feet; third, 2,000; fourth 900, and so on until he gets to the bottom of the sheet. With one stroke of the crank of the machine he has added that; he has the total of the number of feet used by those forty-five consumers. He goes back and takes the same cards; $5.80, $4.80, $2.90. When he gets to the end, with another movement of the crank he strikes the total of that, and if the figures of feet and the total of the amounts agree he is pretty sure that he has not made an error. In that way we take off some 14,000 accounts in about four days, with one clerk, and they are all added up.

The President.—Mr. Nettleton, would you like to say anything on the card system? I remember some ten or fifteen years ago you were the first man to say anything about the card system, but at that time I believe it was in connection with meters. We would like to know what you are doing today.

Mr. Nettleton—Mr. President, I do not recall the incident you refer to. I have had the impression that it was not desirable to use cards, for fear that some might be lost, or mis-

laid or stolen; but it seems to me that Mr. Barnes' experience and Col. Richardson's are very much better than my theory, and I confess that I am probably mistaken. At the same time for my own use I much prefer to have the leaves of ledgers bound up, so that if they are cut out or removed there is some evidence that the property has been stolen. It does seem to me that, in spite of the convenience, which I admit, of the cards, there are also some conveniences attached to using ledgers, as for instance, the balancing of the ledgers at the end of each month; it seems as if it must be a much simpler operation with the book ledgers than with the cards. I admit that the cards of one ledger can be divided among a number of people and that is frequently a decided advantage. On the other hand, by putting two people at work on one ledger, and not having too many accounts therein, the work is turned off very rapidly. I also admit that the printing of the names on the top of the cards with the addressograph is an economy. In this connection I would like to speak of a meter statement book that is now being used at New Haven, which was entirely new to me when introduced last year, and possibly may be to most of the gentlemen present. It is practically a loose leaf statement book. The leaves, which are about nine inches long by three inches broad, are fastened together with brass clamps and placed in strong covers. The names are printed on these leaves with the addressograph, and on each leaf there are twelve places for statements. Each month after the entries on the ledger have been made, and the bills completed, the statement is cut off, and when the book is handed back to the man the next month he has no previous statement to guide him. The result is that there can be no "sidewalk statements," as they are called.

Mr. Barnes. — I would like to say a word about the possibility of the loss of a card, as that seems to be the only argument which I have heard very strongly urged against a gas ledger (and Mr. Nettleton has referred to it again) that it is possible that a card might be abstracted, and he prefers to have some evidence that it was torn out, or destroyed, or something of that kind. Now, as I said in my paper, in our office we divide the work up. For instance, in copying the states from the ledger on to the bill, one of the clerks may do ledger A

this month and not have anything to do with ledger A next month; the sixth clerk may have ledger A. In copying states or in making out the bill we have the record of the addressograph. The addressograph is kept up with every change of the meter, and the bills are all printed from it. If the clerk, going through the ledger, comes across a bill, say that of Mr. Charles Harris, No. 5 Acacia street, and does not find any card for it, you have detected the absence of that card at once, and it is only necessary, if the card has simply been misplaced, to look through and find it. If you happen to find that the card had actually been totally lost, you still have on your meter cards, which I have here, a record of Mr. Charles Harris's account ever since he was a consumer.

Mr. Richardson.—In line with this, and referring to Mr. Nettleton's point, the advantage of the bill we have is that every customer has in his own possession a reading of his own meter each month or each quarter, and the request is printed that he read and verify the statement. Our only record after this is taken is the copy upon the loose leaf ledger, which represents four years' continuous record of each and every consumer. If there is any question upon the successive reading back of the time when the complaint is made, our only record is this meter; but if the customer saves and files his monthly or quarterly account the record in his own possession will show each and every statement that is taken, so that it is "up to him" to keep his own record or verify it, if he chooses.

Mr. Morrison—Mr. President, I should like to ask Mr. Barnes how many clerks take care of his work?

Mr. Barnes—Eight clerks in the office attend to all the gas business ledger work. Part of the time one of the collectors helps to make out the bills, but ordinarily clerks do all the work pertaining to the gas business. That includes taking care of the applications and changing and setting meters. They don't do the changing and setting meters, but they take all the applications, keep the application journals, keep the record of all the changes and of all the complaints, change the addressograph, keep the gas ledger and the ledger cards, and what we call our scattering cards in shape, take and post all the cash and make out the bills.

Mr. Morrison—I wanted to make a comparison with that system and the ledger system; that is, having a bound ledger ruled off into 50 lines, 10 consumers on a page. I have in mind a plant having 10,000 meters in which two clerks do the whole business.

Mr. Barnes—With monthly bills?

Mr. Morrison—Yes. Take the cash and make all the ledger changes every three years.

Mr. Barnes—I should like to make the acquaintance of those two clerks.

Mr. Richardson—So would I.

Mr. Morrison—No; they don't take the cash, but they do all the ledger work. It seems a sort of an indication that perhaps the bound ledger is a little more economical than the loose leaf.

Mr. Barnes—If the gentleman will pardon me, I want to say that I have not the slightest doubt but that I could do all the work on 14,000 meters, so far as posting the cash and so far as he indicates, with two clerks, provided they had nothing else to do. We use our clerks in other work at different times. For instance, our discount day is on the 15th of the month, which is when most of the bills come in. We have to get that all out of the way, get our unpaid bills out of the way, and get our statements out for our collectors, before the 22d or 23d, in order to begin making out bills. Now, I think I am right in stating that two ordinary clerks could hardly make out and enter 10,000 bills in six days. Do you claim that they could?

Mr. Morrison—I presume they don't get it all done on the seventh day, but I meant that they take care of all the consumers' ledgers, the gas sales' work, and a great deal of other work besides.

Mr. Barnes—All they do is posting the cash, you say.

Mr. Morrison—And making out the bills, the routes and all that sort of clerical work.

Mr. Barnes—They make out and enter the bills?

Mr. Morrison—Yes, sir.

Mr. Barnes—And take off the statements?

Mr. Morrison—Yes, sir.

Mr. Barnes—And post the cash?

Mr. Morrison—Yes, sir. I notice another thing, Mr. President. Mr. Barnes seems to go through his route sheets twice. He goes through them once to put on the lower statement, and again after the meters have been read he puts on the upper statement. I think it a waste of time to go over those 14,000 meter cards twice.

Mr. Barnes—Will the gentleman pardon me if I ask him wherein the waste of time comes? It does not take any longer to copy on his previous states to-day than it would to copy them to-morrow, when copying this month's states.

Mr. Morrison—But you have to handle every card twice, after the upper statement is put on. Why not put on both at once?

Mr. Barnes—In our system one clerk makes out the bill, another enters it on the ledger at the same time and one checks the other. That is where the advantage comes, I think. The bills are all ready to be made out, and when the meter card is brought in one clerk takes the meter card and the ledger, reads off, and the other clerk takes the bill, reads off, Charles Harris, 5 Acacia street, state 902. One clerk puts it on the bill and the other clerk puts in on the ledger and makes the subtraction. One says, "58," the other says, "all right," and the bill is all done.

Mr. Morrison—But on the bill you put down the under statement before the meter is read.

Mr. Barnes—Yes.

Mr. Morrison—Why not wait until that meter is read and put them both on the bill at once, instead of handling over the 14,000 cards to put on a previous statement, and then, after your other one is ready, handling them all over again to put on the upper statement?

Mr. Barnes—For the reason that you would have the clerk who is putting down both states pretty busily employed, while the one entering the bills on the ledger would have a pretty easy, idle time of it.

Mr. Morrison—Our system is different. We put the upper and lower statements on at once. One clerk does that. Another clerk takes the route to the ledger and enters it there.

Then when we have got them all done we check them all at once.

Mr. Barnes—From what do you copy your previous states?

Mr. Morrison—From the route sheets.

Mr. Barnes—How do you know they are right?

Mr. Morrison—We know they are right; just as you do.

Mr. Barnes—Don't your meter readers ever make mistakes?

Mr. Morrison—Yes, sir.

Mr. Barnes—Don't you correct them on the invoices, on the bill, or on the gas ledger?

Mr. Morrison—We do.

Mr. Barnes—Then why aren't you liable to have inaccuracies in the bill, if you simply copy the meter states from the meter statement—the previous state?

Mr. Morrison—I did not intend to bring up the question of errors; it was the question of saving time entirely. If it takes eight clerks to take care of that system with 14,000 meters, and two clerks can do it with 10,000, or three clerks with 10,000, say, it seems to me the bound ledger with the loose route sheet is preferable.

Mr. Barnes—Will the gentleman please tell me how large the entire office force is in that company where there are 10,000 meters?

Mr. Morrison—Mr. Nute and I have had a little conference. Affairs stand in this way, as I understand it. Two clerks take entire charge of the ledgers — the consumers' ledgers — with 10,000 meters; that is, they make out all the bills and take entire care of those two ledgers. There are two cashiers who take in the money; one complaint clerk, and an odds-and-ends clerk, who helps out on complaint work and who occasionally helps out on footing the ledgers. These two ledgers have to be footed, by the way, by the night of the sixth of the following month.

Mr. Barnes—You have six clerks for 10,000 meters?

Mr. Morrison—Yes.

Mr. Barnes—Forty per cent. of six would be 2.40. I should make my office force 8.40, on your figuring for 14,000 meters.

Mr. Morrison—My question was how many clerks took care of your ledgers.

Mr. Barnes—They all take a hand in it. That is the advantage of it.

Mr. Morrison—You cannot say, then, how many actually would do it.

Mr. Barnes—What office hours do you have?

Mr. Morrison—Eight to six.

Mr. Barnes—We work from eight to five, or eight hours. We lose one-eighth there. If ours were as smart as yours are we should have to have about ten clerks. Am I right?

Mr. Morrison—It is pretty hard to make a comparison, I see.

Mr. Barnes—I am satisfied with the comparison if you are.

Mr. Richardson—I would like to ask Mr. Morrison what is the size of the ledger in which the 10,000 accounts are kept; and are they all in one?

Mr. Morrison—I presume there are 150 pages to a ledger, possibly more.

Mr. Richardson—Do you know what proportion of the space is unoccupied when they are first opened that is left for the new customers or transfers?

Mr. Morrison—I could not tell that. There are five lines to a consumer.

Mr. Richardson—That is, seven books. Two clerks take the entire work of the 10,000 accounts.

Mr. Morrison—I don't think Mr. Nute has very many blank spaces in his ledgers; I can tell you that.

Mr. Richardson—I didn't know to whom it referred.

Mr. Nute—We have two clerks whose business is simply to take care of the ledgers. They do practically all the work on the ledgers; they do practically nothing else. They post the accounts, make all the changes, all the entries of new meters, changes of meters, all the entries of meters taken out and changed for test, of which we do a large amount. They foot the ledgers and do practically all the ledger work. A third clerk helps them out at times in making bills and in footing the ledgers, which has to be done by the night of the 6th. This third clerk has time to make out all the vouchers for the bills

for the month, spends a good deal of time on the complaint counter at the busy period, and does other work. But two we call ledger clerks, whose business it is to take care of the ledgers, and who do practically all of the ledger work.

Mr. Richardson—That is, 10,000 meters?

Mr. Nute—Yes, sir.

Mr. Richardson—Two do that in six days?

Mr. Nute—The ledgers have to be footed by the night of the 6th.

Mr. Richardson—Do they make all the bills?

Mr. Nute—They make practically all the bills.

Mr. Richardson—And enter in the ledger?

Mr. Nute—They make all the entries in the ledger.

Mr. Richardson—And they work how many hours a day?

Mr. Nute—From eight till six. Of course, we have two cashiers, or one cashier in a quiet time and sometimes three cashiers on the last discount days. There is one clerk at the complaint counter, of course, all the time and two during the busy period. We have one clerk who does only miscellaneous work. I think that includes the office force.

Mr. Richardson—That is about 85 an hour, more than one a minute, working every minute in the day.

Mr. Nute—I don't know that I quite understand what you are figuring on.

Mr. Richardson—Ten thousand bills that are entered twice would be 20,000.

Mr. Nute—Entered twice?

Mr. Richardson—They have to make a bill and enter it on the ledger. That is 20,000 entries. Two people working ten hours a day, six days?

Mr. Nute—Nine hours.

Mr. Richardson—That would be 165 an hour.

Mr. Nute—I did not say anything about the number of days in which they are making those entries; I say the ledgers have to be footed by the night of the 6th. We start indexing generally eight working days before the end of the month.

Mr. Richardson—I was only just looking for those two people, because I need them in my business.

Mr. Nute—We have plenty of them in Fall River.

Mr. Barnes—I should like to say that many sorts of systems have been tried for making people honest, yet hardly a day goes by that we don't see instances where the system has been outwitted. I don't think it is a pleasant thing to contemplate that any one clerk in your office is going to take all those steps to cheat you. If he does, he is bound to cheat you, anyway; he will find some way, even under your system, of doing it. In my office there is this which I think is a protection. One and only one clerk does all the addressograph work. She sets the type for the addressograph and keeps it in order. She very seldom has anything to do with the books; occasionally she does in rush time. If any one else is seen to meddle with the addressograph, the question would be raised at once what was he or she doing with it. Ordinarily the system is pretty well safeguarded, I think, against dishonesty; but, like all other systems, some clerk may be astute enough and shrewd enough to overcome it, but I think the danger is so remote and the other advantages of the card ledger are so great that it is hardly worth considering.

The President—Mr. Addicks has had a great deal of experience in different systems, and we would be pleased to hear from him.

Mr. Addicks—I shall have to correct the President to some extent. The Company has experience with various methods, and it has been discussed for a number of years pro and con, and I think that Mr. Barnes has been quoted very frequently in the office in connection with the work that he is doing with his card system. I, therefore, read his paper day before yesterday with a great deal of interest, and I handed it to our Assistant Treasurer, Mr. F. E. Smith, and asked him to read it over and advise me as to what he thought of Mr. Barnes' experience with reference to the Boston Gas Light Company's experience. Not seeing me yesterday he wrote me a letter covering the points, and I was so much interested in the letter myself that I thought the Association would be interested. I don't think that Mr. Smith altogether agrees with Mr. Barnes. Now, in order to understand what Mr. Smith's letter is referring to, I have brought here the form that he refers to. In the first place, *that* is a leaf of the ledger of the Boston Gas Light Com-

pany. It was formerly made to cover two and one-half years; it is now made to cover two years. There are twenty accounts to a page. There are four lines to each account, providing for changes. To the right of the name is a space that is covered by these loose sheets or the partial sheets which have been referred to, I think by Mr. Nettleton, with the description of the meter and the deposit and matters of that kind. Then follows a column for each month. That, for instance, is June, 1899, July, August, September, October, and then this short sheet turns over and we have November, December, January, February, March, April, May, June and July. I don't know how many partial sheets there are in this ledger, but sufficient to give two years' bills. You will notice that the twenty accounts appear one under the other, which makes it easy for the auditor. In order to determine the question as to whether our standard ledger was the better plan, a loose leaf ledger was adopted in one district, as will be shown by the letter which I will read presently and which will explain itself. This differs slightly from Col. Richardson's, in that it covers eight years; that is to say, four years to a page, making eight years altogther, if you wish to keep the two pages for a single consumer. Otherwise it would be, of course, four years. In connection with that we have the card system for taking the meters. This has four lines for any change of name, and three lines here for a change of business or location, and then there is room on each card for two years' of statements of the meter. Now, with this explanation, I will read Mr. Smith's letter:

"W. R. ADDICKS, ESQ., Chief Engineer, Boston Gas Light Co.: *Dear Sir*— About two years ago we wished to make a trial of either a card or loose leaf system, and decided in favor of the loose leaf system in preference to the card system, as we thought it had some advantages. This trial was given in charge of one of our brightest and most experienced bookkeepers, who entered on the work with a disposition to get all the good points possible, and to analyze its merits or demerits as compared with the old style ledger.

"One district having over 3,000 accounts was thoroughly fitted out with three loose leaf ledgers, each ledger holding about 1,000 accounts. These leaves are secured in binders, size $16\frac{1}{2}$ inches by 11 inches, which are locked, the key being

kept in the treasurer's safe, and were only unlocked by the treasurer when new account leaves were to be inserted. This prevents the leaves being taken out intentionally or being lost. We also changed in this district our method of taking meter states from books to cards, secured in locked binders.

"After two years' thorough test we have decided that the old style ledger is best for our use, and will abandon the loose leaf system. We shall retain, however, the card or loose leaf method of taking our meter states, and have adopted it in all districts in place of meter books.

"Our experience shows that the advantages of the card or loose leaf system are as follows:

"1. A more compact and lighter book, instead of the heavy bound ledger; the loose leaf ledger being easily handled, and may be taken to the counter and shown to customers in cases of dispute, which would not be nearly so convenient with our old ledgers.

"2. The better comparison of accounts, as in the loose leaf system the accounts are in columns, and any bill out of proportion with the preceeding bills can be more readily detected and verified.

"3. Saving in labor in making new ledgers, as the card or loose leaf system can be made to last two or more times the life of the old style ledger.

"4. Placing new accounts in proper order.

"The disadvantage, which to us has more than counterbalanced the many advantages and merits of the card or loose leaf system, is the longer time it takes to do the work. In the old style the ledger has twenty accounts on one page. At the end of the month the footing of each ledger page is transferred to a registry. In the card or loose leaf system to get the total a record has to be made of each of the 3,000 accounts, while to record the old style ledger we only take 150 totals in pages, if each page contains twenty accounts. To allow for expansion a district has three ledgers of a little over 100 pages each, so that it means about 300 totals to be added instead of 3,000 by the new system. Although by the loose leaf or card system we have used an adding machine, we find that it takes about

one-third more time, and the liability of mistake is much greater.

"In entering our states from meter cards we find it easier to enter twenty states on one page than the same number of states on twenty different sheets. In posting cash the coupons are sorted and entered in our ledger by page number and line, so that a collector on going through a district would have many on the same street and page. This enables the bookkeeper to make several postings on one page instead of having many different cards or sheets to handle.

"The element of safety in a bound book over loose sheets or cards, is, we think, worthy of being considered, and the bookkeeper and collector, if the ledger is locked and key under the treasurer's care, have a little sensitive feeling as to the corporation's opinion of their trustworthiness.

"In all the details of the business we find that, making allowances for the many excellencies of the card or loose leaf system, it takes at least 25 per cent. more time to do the same work, and there is more liability to error in taking off monthly trial balances.

"For these general reasons we have decided to keep our accounts on the old style ledger."

I want to say, gentlemen, that Mr. Smith said in connection with this that if he had a small company to care for, one of a few thousand accounts, he would prefer the loose leaf system as far as the convenience of it went. I have added this, Mr. Barnes, to your paper, as I thought it would be of interest to know what the result would be as far as our office was concerned, with some 30,000 or 40,000 accounts. I know nothing about the actual workings of this, and therefore as far as I was concerned I am in an entirely unprejudiced position. Mr. Smith's experience applies to very few companies in the Association.

Mr. Barnes—I am very glad, Mr. Addicks, that you brought it in, as my object in bringing the matter here in answer to the question of the President was for a full and free discussion. I am as much interested in Mr. Addick's statement and Mr. Smith's letter as any of you, I think, and I can see the force of some of his objections. Still, I do feel that, taking all in all,

for a company of our size at any rate I should still prefer the card ledger.

Mr. Addicks—I think Mr. Smith agrees with Mr. Barnes in regard to his company, but it does not apply to the larger ones.

Mr. Woodward—If I may add one word. Speaking of these devices for saving labor in an office we have used for a good many years a set of rubber stamps for making extensions on gas bills. Probably most of you are familiar with it. It is a great labor saving device, and you are sure of the accuracy of your bill. I would recommend all to look into it. It makes a neat looking bill.

On motion of Mr. Nettleton, seconded by Mr. Woodward, a hearty vote of thanks was tendered to Mr. Barnes for his paper.

Mr. Barnes—I will leave these ledger cards here, if anybody cares to look at them. They are a reproduction of a part of my ledger, but as it is not the actual ledger, no harm will come to me if Mr. Nettleton should abstract one and put it in his pocket.

Mr. Nettleton—I shall.

The outlines of two of the cards submitted by Mr. Barnes are here reproduced:

A8 Mrs. C. C. Voorhees,

8½ Ash St. Pl.

Size 3	Meter Number 51819				

Date	Index	Reader	Date	Index	Reader
Ja 24	969	W H	Ja 24	110	C N R
Fe 21	987	W H	Fe 21	131	J P
Mr 24	007	J P	Mr 25	140	J P

| 8½ |

C A8 MRS. C. C. VOORHEES,

8½ Ash St. Pl.

Date of Bill	Register	No. of Feet	Bill Rendered	Amount Paid	When Paid	Remarks
1900	929				1900	51819—3
Jan. 1	953	24	240		Jan 11 1900	4
Feb. 1	969	16	160		Feb 2 1900	4

REPORT OF COMMITTEE ON NOMINATION OF OFFICERS.

Mr. Allyn — Mr. President, the committee appointed to present a list of officers for the ensuing year respectfully submit the following names; but before doing so I would like to state to the members that we learned with a good deal of regret that our present incumbent of the chair positively declined to be a candidate for re-election. In fact his declination was put in such positive terms that we thought it was useless to go through the formula of nominating him only to have him decline to serve:

President.—Mr. William E. McKay, Boston, Mass.

First Vice-President.—Mr. F. S. Richardson, North Adams, Mass.

Second Vice-President. — Mr. Wm. McGregor, Pawtucket, R. I.

Secretary and Treasurer.—Mr. N. W. Gifford, New Bedford, Mass.

Directors.—Messrs. Walter G. Africa, Joseph E. Nute, William H. Snow, Benj. J. Allen and T. H. Hintze.

ELECTION OF OFFICERS.

On motion of Mr. W. R. Addicks the secretary was instructed to cast the ballot of the association for the officers nominated. Mr. Addicks was appointed teller. The secretary subsequently reported that he had carried out his instructions and the result was announced by Mr. Addicks.

Responses.

The President named Mr. Prichard a committee of one to escort the President-elect to the chair, which office having been duly performed, President McKay made the following acknowledgment:

Mr. President and Gentlemen of the Association: If I may use the first words that I speak in such a way I would support what was said by the Chairman of the Committee on Nominations in expressing the regret that I feel that Mr. Learned will not continue in his present incumbency. In all the years that I have been a member of this Association the effort has been to get him on his feet with a paper, and by electing him President I think we got one of the finest papers we ever heard. (Applause.) For that and for all the other reasons that occur to all of you I feel very sorry. Leaving sorrow on one side I take up the joy, on the other hand, that I feel at the great honor you have conferred upon me in electing me your President for the next year. The pathway to this office in the Association, going as it does through the Directorate, the Second Vice-Presidency and the First Vice-Presidency, is a very pleasant path, strewn with primroses, and "Vices," and on the way I have become so habituated (may I say, so acclimated) to the "Vice" that I leave it reluctantly. I regard it as an especial honor to be chosen President of the only Association of Gas Engineers in the United States or in the Western Hemisphere. This is the Thirty-Second Annual Meeting of the Association, and I feel that you have in a measure conferred upon me the Thirty-Third degree. (Laughter.) I trust, gentlemen, that when I am initiated I may have your support and your leniency.

The President—We all like to hear of course once in a while from our Secretary and Treasurer.

The Secretary—Mr. President and Gentlemen, I think you have heard from him often enough. I would only say that I am surprised at your leniency and willingness to continue to hear from me longer. I thank you, gentlemen, for the honor you have done me.

The President introduced Mr. C. J. R. Humphreys, of Lawrence, Mass., who read following

Report from the Committee on Selling Gas.

To the President and Members of the New England Association of Gas Engineers: At the close of a paper read by Mr. C. J. R. Humphreys at the last meeting of the Association, it was suggested that a committee or bureau be appointed to gather from the members data as to the purposes for which gas is used in their respective territories and to report back to this Association; whereupon a committee was appointed to take up this subject and they respectfully report as follows:

So many papers have been written of late years upon the gas range, and the best manner of handling this part of our business, that it seemed best to your committee to deviate from the beaten track and deal with uses of gas not so well known as that generally comprehended by the term gas for cooking purposes —pausing only to remark that the gas range continues to grow in favor, and to-day forms a substantial portion of the business of many gas companies. And to that purpose your committee sent out inquiries to the members of the Association asking for information touching the uses of gas which had come under their attention.

Your committee hoped that it might have been possible to group the answers in the form of a table, but as this did not appear feasible they will treat the matter in a general way.

Gas for heating purposes continues on the increase, generally as an auxiliary to the furnace or boiler; but it is understood that in Boston gas has been used in this regard in a more comprehensive way—by using a large gas burner in the furnace or boiler—but it hardly appears that this use of gas is an assured success; and this is certainly the general tenor of the replies received by the committee. Nevertheless gas is used largely for, if we may so say, room-heating, as distinct from the more comprehensive term house-heating. Some companies use the cylindrical stove, others prefer the radiator, while the Backus heater is in favor in many cities, and these are supplemented by the gas log and the gas grate. In several instances gas companies have paid particular attention to placing gas radiators in lodging houses where heat is needed only in the morning and evening. Speaking further on this subject your committee would note that Mr. E. C. Jones, taking advantage

of the climatic conditions of San Francisco, has installed a large number of heaters in apartment houses. This is feasible on account of the mild climate, which does not call for steam boiler or furnace.

The gas engine continues to be a source of revenue to many gas companies. One member, in a moderate sized city, reports that he has one ten-horse power engine running a box factory, one eight-horse power in a carpenter shop, one $5\frac{1}{2}$-horse power for an artificial refrigerator, while another one of like power is engaged in drying fish; a three-horse power runs a soda water generator, and a one-horse power provides the motive power for a bicycle shop. Another well known member, who does not indulge in the luxury of an electric adjunct to his gas plant, runs a gas engine for driving an isolated electric plant. One of our members speaks very hopefully of the future of the gas engine, and adds: "And when installed under our supervision are not liable to give us any trouble, but where the gas bag at the supply is of canvas merely coated with rubber and devoid of elasticity it is apt to interfere with a uniform pressure on the gas main."

The use of gas for expanding wagon wheel tires and locomotive wheel tires seems to be on the increase. Laundries seem to be contributing to the increase of gas sales, by using gas irons and for heating gas mangles and drying machines. In many fire engine houses and police stations gas is used in quickly giving a supply of hot water. Some prefer the Monarch type, others some form of the instantaneous. The requirement of the boards of health that every barber shop shall have running hot water has led to the installation of hot water heaters in many moderate sized cities. Gas seems to be used for popping corn and roasting peanuts with success.

Gas is made use of very extensively for brazing, annealing and tempering. One member has replied so fully on this point, that I will quote largely from his letter.

"(1.) *For Brazing.*—It is used in a furnace about ten inches wide, twelve inches deep, and eight inches high for brazing lugs on the underside of single barrel shot guns. The gas is supplied by two burners, slot shaped, about $2\frac{1}{2}$ inches long by a little less than $\frac{1}{8}$ inch wide. Gas is carried in by means of the air blast.

"(2.) *For Bluing and Annealing.*—This is done in pots of various sizes, from, say, eight inches wide, ten inches long and ten inches deep, to 14 inches long and 18 inches deep. Under the latter size the burners are four in number, one at each corner, and the gas is supplied in a pipe around a jet which supplies an air blast and makes air and gas both issue from a $\frac{3}{4}$-inch pipe.

"(3.) *For Lacquering.*—For this purpose an ordinary cooking oven is used, placed upon a hot plate, and seems to answer the purpose very well.

"(4.) It is used in various places for heating small soldering irons.

"(5.) One factory has ordinary Bunsen burners on the work benches in front of the workmen, who use the gas for brazing small pieces, and in various other ways.

"(6.) An ordinary gas flame is used in one place to soot over gun parts to aid in making a better fit, as the soot rubs off where the fit is too close.

"(7.) *For Tempering.*—One place contemplates putting in ovens for tempering springs, the ovens to be heated by gas. The machine is estimated to use about 1,000 cubic feet per day."

This description is given as an indication of the thought that the construction of burners for brazing purposes must be designed carefully, and it is also true that burners must needs be adapted to each special case; and it seems well established that gas for annealing, brazing, tempering and similar purposes is made use of in very many places. One member calls the jewelers good customers; others find wire mills calling for a large amount of gas; while tempering tools and spindles and needles will contribute to the gas sales, if looked out for properly, according to the reports of many members. Newspapers are now very generally using gas in their type-setting machines, and for melting the type. Large quantities of gas are used in mills for singeing of one kind and another. In several instances gas is thus used in woolen and cotton mills. One silk mill is reported which makes a like use of gas; also a brush factory where the bristles are singed. Japan and China ovens heated by gas are very generally reported by our members.

Gas appears to be in favor in tin factories. Two members report the use of gas in the manufacture of electric bulbs; one mentions a like use in a glass factory for heating and bending glass.

Another member says: "Inspecting the laboratory of a very successful dentist, I was much interested in the means he employed for heating the crucibles in which were the moulds that required exceedingly high temperatures. A wire from an electric service furnished current for a small motor that turned a minute blower; the forced blast met a series of streams of gas, and the burning mixture gave a temperature so high that the best crucibles were well tested for endurance. The rates of heating and the temperature were under complete control, and the system was excellent."

Mention is made of one case where, in a bakery, gas is employed in heating the tins before they are placed in the oven.

In this running manner your committee has noted the summary of the information which has come to it during the year. If the members would keep a closer record of their work in this direction, your committee thinks that another year it might be possible to get together much more information on this subject, which all tends in the direction of increased gas sales.

C. J. R. Humphreys,
Chas. F. Prichard,
William McGregor,
Committee.

On motion of Mr. Addicks, seconded by Mr. McKay, the committee was thanked for the report, and its continuance ordered, with instructions to submit a further report next year.

The President named as the

Committee on House Piping

Messrs. S. J. Fowler, J. J. Humphreys, Jr., and Z. M. Jenks. The President explained that, as the Association would have to vacate the meeting room at 5 o'clock, and as the adjournment hour was close at hand, the intervening time would be taken up by discussing some of the questions in the question-box. The first question considered was:

"What is the smallest size of purifiers that can be used satisfactorily in water gas manufacture making 1,000 cubic feet per run, of four and five minutes blowing?"

The President—Mr. McKay?

Mr. McKay—Mr. President, after listening to the way you extracted the sulphur from that 750,000 feet, using only a pumping engine and a spray, the size might be put very low. I should like, however, to hear some one tell more about it.

The President—It seems to me that question really should be answered. How is it, Mr. Nute?

Mr. Nute—I am inclined to think the question is rather indefinite. If it were said how much per hour I should understand better how to reply to it. You say in four or five minute blows; I don't know whether the runs are to be six, eight, ten or more minutes.

The President—The question says "Making 1,000 cubic feet per run of four and five-minute" blows.

Mr. Nute—What is the length of the run?

The President—The run is probaby four minutes and the blow is five.

Mr. Nute—Is there a relief holder? All those things are very essential.

The President—Assuming there is no relief holder and that he is making direct into the commercial holder.

Mr. Nute—Having had no experience in that line, I should not care to answer such a question.

Mr. Allyn—Mr. President, although I am new in the business I would suggest that if he has not a relief holder he ought to have one.

The President—Mr. Slater, what do you say?

Mr. A. B. Slater, Jr.—If I understand the question, it is 1,000 feet for a five-minute run.

The President—No; making 1,000 feet per run of four and five minute blowing.

Mr. A. B. Slater, Jr.—That would be about 6,000 feet an hour, as I understand it, or 144,000 feet a day. I believe that for water gas, on account of its usually having a less proportion

of sulphur than coal gas, it would be fair to assume about one square foot of purifier area to about 2,000 feet of gas per 24 hours, if he was using oxide with a depth of not less than four feet per box. That would make the boxes about 72 square feet, or about eight feet by nine feet, but if he has no relief holder the boxes should be about twice that area, or say ten feet by fourteen feet six inches.

The President—That would be about the English method of figuring. If it is 144,000 feet per day, taking Newbigging's formula, that would be $\frac{6}{10}$ of that, the square root of which would be about nine by nine. That is all right for coal gas, so that there would be a smaller size if you were running water gas. But another point that has to be taken into consideration is whether you intend that the purifiers are to be four single ones or two double ones, and allowing the gas to come in the middle and decrease the rate of flow and making a marked decrease in pressure. That, of course, would be essential, if this man were making direct into the commercial holder.

Mr. A. B. Slater, Jr.—That opens up the question of time of the contact of the gas with the material, and I believe that, within reasonable limits, it is not the velocity of the gas through the material but the time of contact of the gas with the material that is the important factor. The size of the boxes would be, therefore, determined with regard to the cubical contents rather than the area of the horizontal plan only.

Mr. Holmes—Mr. President, I don't know whether or not I can do anything to help out the discussion, but I might say that for a good many years in actual practice the company with which I am connected used the smallest size U. G. I. Co.'s water gas set; four feet diameter. My recollection is that ordinarily the runs were about ten minutes and the blows were the same, except when they were coaling up. We had no exhauster. We used a commercial holder, and the gas was forced through the purifiers into that holder by the pressure of the works. We had a set of four five-foot purifiers, of which we used three, running from the center and then in series, keeping one idle all the while. Our runs were from 1,250 to 1,500 feet per run; sometimes 1,750.

The President— Mr. McKay.

Mr. McKay—I find that, making direct from the machine into the holder, a matter mentioned by Mr. Allyn, up to a rate of make of 300,000 per hour, twelve bushels per 1,000 would purify satisfactorily; on the basis of the 24-hour make, this would be ½ bushel per 1,000.

The President—The next question is:

> "Why not have meter unions with ground joints like common brass unions?"

Mr. Macmun, what do you say?

Mr. Macmun—My judgment, Mr. President, would be that the ground joint is susceptible to damage, thereby causing leaks which could not be remedied easily, whereas in the other joint you have an opportunity to build up by small washers.

Mr. Allyn—I would say in reply to Mr. Macmun that we have often found leaks where the couplings were built up with leather washers as he described and we have found a washer on one side and no washer on the other, the result being a decided leak.

The President—The next question is:

> "Why separate the exhauster room from the condenser room?"

The President—How is it with you, Mr. Prichard? Haven't you that arrangement?

Mr. Prichard—We didn't have space enough to put our condensers in the exhauster room; but I think, Mr. President, the criticism might be made that oftentimes in a condenser room, especially if you have tar extractors and various appliances of that kind, more or less of a smell of ammonia gets about, and you are not able to keep the exhauster room in as good condition as you would like. There are more open drips and more possibilities of tar, etc., splashing about in the necessary cleaning.

The President—What do you say, Mr. Coggeshall?

Mr. Coggeshall—I would say our exhauster, condensers, scrubbers and meter are all in the same room.

The President—Somebody says, "Ask Mr. Slater."

Mr. A. B. Slater, Jr.—It seems to me the points Mr. Prichard mentioned cover the case pretty well. The only thing I would add is that in opening up your condenser and scrubber room you clean out your apparatus and have more or less free gas, maybe, there, and it is better to have your exhauster and engine in a room where you can have a light for oiling up and adjusting a belt, etc., if you want to, without having any other gas apparatus in the same room.

The convention was then declared adjourned to 10 A. M. of Thursday.

Second Day, Feb. 20 — Morning Session.

The sessions of the second day were commenced pursuant to the order for adjournment. The President introduced Mr. Charles F. Leonard, of Fall River, Mass., who read the following paper on

Some Details in the Operation of a Water Gas Plant.

It is the aim of this paper to bring together a few points, which have appealed to the writer in a comparatively brief experience in charge of a gas works using the Lowe process.

In the double superheater type of Lowe water gas apparatus, oil is generally introduced at the top of the carburetor where it meets the water gas made in the generator, and passes with it down the carburetor, up the superheater and out through the take-off pipe to the wash box. The purpose of the carburetor and superheater, filled with a checker work of firebrick, is to break up this oil so that it will give the highest possible illuminating value to the water gas per gallon of oil used. To do this the checker work must have the right gradation of heat throughout its entire course, and this gradation depends on the kind of oil used.

When two bodies, one hot and the other cold, are in contact, heat will flow from the hotter to the colder one, but the rapidity of this flow or the rate of conduction varies approximately as

the difference in temperature between the two. During a run heat is flowing from the bricks all the while, until the gas leaves the top of the superheater, but the rate at which the heat is flowing is greatest at the top of the carburetor, and gradually diminishes. In the Lowe process, water gas is being generated at the same time that the oil is introduced into the carburetor, and, meeting the oil, forms a gaseous envelope about it, and protects it from overheating all through its course through the machine. Even with this envelope, if the heats are too high, lampblack, and if too low, tar, will be formed in the gas above the normal amounts, and these detract from the efficiency of the oil as an enricher.

There is apparently an ideal gradation of temperature which will break up the oil just enough. Oil should not be subjected to the same heat twice, because if a hydrocarbon series is exposed to a higher heat than necessary it is damaged. The longer the run the greater is the drop in temperature through all the bricks. This would indicate that the shorter the run the less this ideal gradation in temperature is varied from. The practical application of this is that if runs of certain length are being used, and after each run the carburetor and superheater are comparatively black, it may be well to try shorter runs.

The common method of judging heats is by the naked eye, but recently an instrument, known as a blue glass pyrometer, has come into use which is a decided help. This instrument was described in a paper read by Mr. E. A. Earnshaw, at the Denver meeting of the American Gas Light Association in 1900.[1]

Our gas machines in Fall River are of the double superheater type. We are now using gas oil and anthracite coal; size, broken. On a fresh machine we use a certain combination of heats as expressed by the pyrometer, and as the machine grows older we raise the heats. The reason for raising them is that, as the machine gets dirty, the carbon deposits in the bricks incandesce and hide to a certain extent the real heat of the bricks, so that if the same number of blue glasses were depended upon as in a fresh machine the checkers would not really be as hot as indicated. Experiment alone can determine what is the best combination to use on a given machine. For

1. See *Am. Gas Light Journal*, Nov. 19, 1900; p. 802.

several months of 1901 we found an average increase in oil efficiency—that is, a higher candle power per gallon—of about ten per cent. over the corresponding months of the previous year, which was partly due to a closer approximation to the proper heats, made more easy by the use of the pyrometer.

If the oil spray is so set as to inject the oil into the center of the carburetor, the heat to vaporize the oil is absorbed from the middle bricks, and at the end of a run the carburetor is streaked. That is, the bricks near the circumference are hotter than the ones in the center, which look comparatively black; and, vice versa, if the oil is sprayed toward the circumference, at the end of a run the center bricks are hotter than the outer ones. The oil spray should be so regulated as to throw the oil evenly over the cross sectional area of the carburetor, and at times the spray requires to be manipulated more or less at different runs to secure this.

The height of the bricks in the superheater is a mooted point. We bring ours now to the top of the top manhole, although in the past we have kept them lower by a couple of feet. The advantage of bringing them up is that through the top sight-cock of the superheater the checkers can be seen and heats judged better than when kept down and the interior lining of the superheater alone is visible.

The extra bricks in the top of the superheater may give slightly better results in the hands of a skillful operator, while it is probably better to leave them out with one of limited experience. If the bricks are kept down too low in the superheater the gas has a tendency to drop its candle power on the street. The spacing of the bricks admits of variations. In our carburetor the spacing is two inches, the bricks being nine inches by two and one-half inches by two and one-fourth inches in size. In the superheater the spacing is one and one-half inches, the size of the bricks being nine inches by two and one-half inches by four and one-half inches.

If the superheater, particularly at the top, gets too hot, it is not always easy by the manipulation of the blast valves to get it down. The cooling can be quickly done by having a steam pipe about one inch in diameter tapped into the connection between the carburetor and the superheater, and also one about half way up the superheater, and allow the steam to blow in

while on blast. This brings the heat down quickly, although if the steam is allowed to remain on too long the superheater may be cooled too much. Too high heat in the superheater spoils oil results, and the introduction of steam when necessary saves time and oil, and assists greatly in maintaining uniform candle power.

Length of blow depends on the condition of the fire, heats required and blast pressure used. With a high blast pressure there is a tendency for the superheater to get too hot, even when the carburetor blast valve is open and the superheater blast valve closed, the high pressure apparently driving the combustion over into the superheater before it has had a chance to take place in the carburetor to the extent that it ought. To remedy this it may be more desirable to cut down the opening of the generator blast valve rather than diminish the speed of the engine. If the speed of the engine is diminished the total amount of air delivered to the generator, carburetor and superheater is cut down, whereas if the generator blast valve is only partially opened the amount of air going into the generator alone is reduced.

Heats can be raised to a desired point under a high blast pressure quicker than under a low one, but while the heats may be up, the fire may not be hot enough to give a good-sized run, in which case it is necessary to shut down the carburetor and superheater blast valves, and allow the generator blast gases to blow through the machine and up the stack. That is to say, if seven minutes is the usual length of blow, and the heats are high enough in five minutes, it may be necessary to blow two minutes longer to get the fire hot enough. This is a waste of coal for two minutes. Our practice is to go on the run as soon as the heats are up in the carburetor and superheater, but we find it necessary at times to blow a little longer as just indicated.

The differential gauge which indicates the difference in blast pressure between the top and the bottom of the fire is a convenient index of the condition of the fire. We usually run nine inches, but there is a tendency to cut this still lower to five and six inches, particularly where short runs are made, as when coke is used for fuel. With a high blast head we find a fire will give larger runs than with a low one, but the make will

drop faster and there will be a wider variation between the size of the first runs just after cleaning and the last ones just before running down to clean again. While a low pressure head gives smaller runs, the make is evener and the fire lasts longer before requiring to be cleaned.

As has previously been said, the fire must be at the right temperature when putting on a run. It is a question here between a deep and a shallow fire. The deeper fire seems to have the advantage, because it gives a larger make per hour, and also because a higher percentage of the steam supplied to it is decomposed than in a shallow one, which means less boiler fuel.

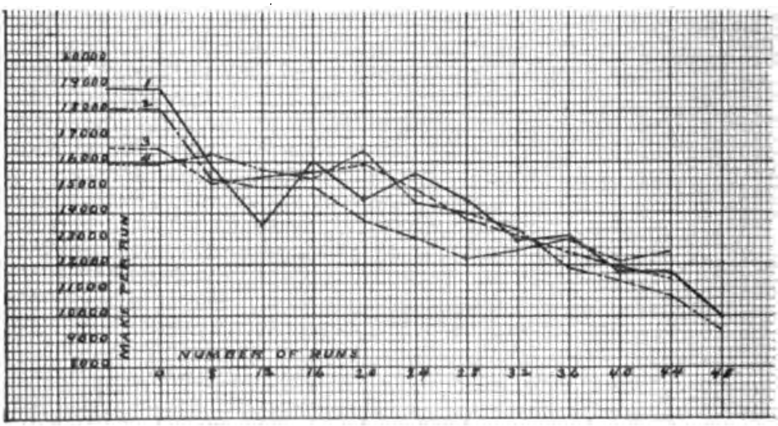


FIG. 1.

On starting up after cleaning a fire the make is at a maximum and gradually diminishes until cleaning time again. The curves in Fig. 1 give an idea of how the make drops under our conditions during the period of about twelve hours from the time of cleaning until the fire is run out. These four curves were plotted from data on four different days. The blast pressure at the bottom of the generator was sixteen inches. The relief holder and station meter were read at the end of each four runs and the make per run computed. The makes indicated can only be taken relatively, as the temperature of the station meter was about 80° F. The first four runs are

abnormally high, as the exhauster was not started until the relief holder had partially filled, it being almost empty at the end of the first run. They do bring out the point, however, that there is a very material drop in the size of the run as the fire grows older, and that it is necessary to cut down the number of gallons of oil used per run with the make to get oil results. While running one machine it is a comparatively easy matter to find out how fast to cut the oil, by taking the station meter reading and the height of relief holder, say every four runs, and figuring up the oil per 1,000. The candle power of the relief holder taken at the same periods will show whether the oil is being reduced too fast.

The frequency of coaling depends on the size of the apparatus and fuel used. In an eight feet six inches set we put in 1,200 pounds of anthracite each four runs, the runs being eight minutes long. Twelve hours is generally the length of time a fire is run. When it is necessary to run fourteen or fifteen hours, instead of making a full clean at the end of twelve hours, then starting up and letting the fire lie over until next day, we make a small clean; that is, rake out at the stoke holes a little and slice the fire slightly at the grate, but do not attempt to clinker other than to settle the fire. This is merely a device to get over a few hours when the extra time needed does not justify a full clean. If for any reason the steam does not pass evenly through the fire, but instead passes up one side, a black spot will appear much sooner than it otherwise would and the make becomes so low as to make it advisable to clean. One advantage we have found in using an up run and a down run alternately instead of two up runs and one down run is that a fire will last longer.

Two minutes before the end of a run the oil is shut off to allow the machine to purge itself, and one-half minute before the end of a down run we change over and reverse the steam.

The length of time required to clean fire depends on how hard the clinker is and the number of men put on it. If it is fairly soft with four men it takes on our machines about 70 minutes; sometimes less and sometimes more.

In starting up a machine after it has been shut down, it is difficult at times to get up candle power right away. One way to help matters is to have a steam connection running to the

bottom of the wash box, and one each to the inlets of scrubber and condenser, and heat up all three before starting. The gas first made is thus not suddenly cooled and required to give up its sensible heat to the wash box, scrubber and condenser, which would have a bad effect on the candle power.

The oil used per 1,000 and the candle power results obtained indicate at once whether the machine is doing good work or not. If it is not, there are several places to look for trouble. The overflow from the scrubber can be looked at for either carbon or tar, which means too high or too low heats, respectively. If during a run the gas is allowed to blow out of the sight-cocks, the color of it is a rough indicator; at the bottom sight-cock of the carburetor it is a bluish color; at the bottom sight-cock of the superheater, a bluish brown, and at the top sight-cock of the superheater a still darker shade of brown. By trying the colors when a machine is doing well a rough standard can be obtained by which to judge when results are poor.

In case of trouble the carbon dioxide test is a good place to look to. Too much or too little steam quickly results in poor work. The rule generally given is to admit enough steam during a run to get three per cent. carbon dioxide in the finished gas, but no more. In 1899, at a meeting of the American Gas Light Association, Mr. A. G. Glasgow[1] stated that each per cent. of carbonic acid in illuminating gas is equivalent to the loss of about two-thirds of a candle in the illuminating power of the gas. This approximate figure was determined in many different places by very comprehensive tests.

A method of determining quickly the candle power in the relief holder with a fair degree of accuracy is a great help in running. We use a 60-inch bar with an Edgerton standard fitted up on the generator floor, the operator making a test once an hour.

The periodical blasting of the carburetor and superheater, the blast not being on the generator, helps to keep the machine clean. The carbon on the bricks unites with the air and burns going up the stack. If a machine has been acting badly, and there is evidence that carbon has been deposited to a high

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1 "Carburetted Water Gas as a Coal Gas Auxiliary;"
—*Am. Gas Light Journal*, Nov. 13, 1899; p. 766.

degree, it may pay to blast immediately. This may leave the superheater too hot to make gas efficiently right away, and it will have to be allowed to cool down by letting the machine stand idle, or else cool down with steam, if necessary to start the machine at once. The best time to do it is just after the fire has been run down, and the machine is to be idle for several hours.

If a machine is run carefully the take-off pipe ought not to clog with carbon. We find enough, however, to warrant cleaning once in three weeks, when the machine is being run continuously.

The length of time a machine can be run without renewing bricks depends on whether the drop in oil results is more than counterbalanced by the cost of renewal. We run ours on about an average of three months of 24-hour days. In a large output the cost of cleaning the bricks is a comparatively small item beside poor oil results, and it pays to err on the side of cleaning out too often rather than the reverse.

In renewing checkers, steel brushes are used to clean off the dirt, replacing all that do not crumble and are in fair condition, and putting new ones in the carburetor at the top and in the superheater at the bottom, as they absorb heat better than the older ones.

The stoke hole castings have to be renewed occasionally, because the fire falling down at cleaning time burns them. Firebricks shoved in to push the hot coals back save the castings, but if not attended to at every cleaning the castings burn off eventually, the firebricks above them crumble, and allow the fire to get against the shell, and it may be necessary to shut down the machine even before the condition of the checker-bricks warrants.

All valves need to be looked to frequently; both stuffing boxes and seats. For instance, if the up run steam valve leaks during a blow it tends to cool off the fire and defeat the very purpose of the blow.

The Bristol recording pressure gauge, besides showing at a glance the blows, runs, coalings and shut-downs, is also a permanent record of the blast pressure, and also the pressures of the machine while making.

A large number of different factors enter into the operation of a water gas machine, some of which are coal, oil, blast, heats, condition of firebrick, and a multitude of small but important things, which afford opportunity for a wide range of difference of opinion and practice, and a very fertile field for investigation.

Discussion.

The President—Gentlemen, the paper is before your for discussion. We would like to hear from Mr. J. J. Humphreys, Jr., of Worcester.

Mr. J. J. Humphreys, Jr.—I should like to know what Mr. Leonard means when he says that oil should not be subjected to the same temperature twice. I presume he means in relation to that gradation of temperature which is ideal and which we don't get. Also Mr. Leonard seems to have a spray that will throw towards the center or towards the outer edge. I would like to know the kind of spray that he uses. He gives the time during which this set runs without clogging up, but that does not seem to be in a way that we can understand. It would seem better if he would tell us how much gas he makes without removing his checkerbrick. He says in the high blast there is a tendency for the superheater to get too hot, even when the carburetor blast valve is open, and that it fairly blows the heat over. Perhaps that water gas set does not have as much air as they could use on the carburetor. Has he one or two blast pipes on his carburetor? The chart shows at the beginning of the day, for the first four runs, an average on one of his tests of 19,000, running down at the end of twelve hours to 10,000. I should like to ask him if he has considered whether the economy of the set is not just as good making his runs more per run but less runs per twelve hours, by cleaning oftener, and keeping his fire in more nearly average condition. Also, he seems to have some trouble with starting a new set as to low candle power, but that I think is a matter of treatment, and that he will probably find with low enough heats he can start a new set just the same as a set that had been running for months. I would like to know if the gas oil has say 30 per cent. of heavy oils, and if he is running to save his light oils in it, how he can tell when he is a making too much tar by his eye

from the wash pots. I also want to know how that operator who is part of the time on the floor makes his test once an hour; whether he stops running for five minutes or just makes a quick one-minute test, which is not quite so accurate.

Mr. Leonard—Regarding Mr. Humphreys' question as to why oil should not be subjected to the same heat twice, we carry our heats the highest at the top of the carburetor and gradually diminish them down the carburetor and up the superheater, and, as I understand it, if we break up oil, when we first break it up, certain series of hydrocarbons are formed which should be subjected to gradually diminishing heat. If you overheat them they are going to be broken up too much. We use a Collins oil spray. We find that if we get it set just right it will spray evenly over the carburetor, but at times we do find a streak towards the circumference and sometimes in the center, so that the gas maker has to manipulate it at different runs and is able thereby to keep the heat even.

Mr. J. J. Humphreys, Jr.—What I want to know is whether you use a hollow cone spray, or a spray in which the jets supposedly dash against each other, but that when one jet stops the others all cross.

Mr. Leonard—We use a hollow spray. There is also a small, round valve having four holes in it, and you open and close that. It throws the oil to the outside from the center. Regarding how much gas is made without renewing the checkerwork checkers. We have an ordinary eight-foot six-inch set. When I say that we renew the checkers on an average about once in three months, that is only an approximate figure; sometimes we do it oftener, sometimes not so often, but on the average, supposing that we are running ordinarily as the curves would indicate, starting with that make per run and running down the scale, we run three months with a twenty-four-hour day, and we think it is about time to renew. But sometimes, if we have bad luck, we have to clean oftener, and sometimes we don't do it so often, particularly in the summer time. I have no figures as to the make of gas; at least, I don't remember how much gas we make when we have to renew. We have one blast pipe going to the carburetor. Regarding the combustion being thrown over into the superheater under high blast pressure, we have found sometimes that when using the high blast pressure

the top of the superheater gets too hot and by manipulating the blast valves we are not able to get it down. By lowering the blast pressure that difficulty is overcome to a certain extent. As to low candle power at the starting up of a new set, what I meant was that in the morning, if you stopped say the night previous at six, seven or eight o'clock, and the machine had a chance to cool down, when you start the machine making gas into the relief holder the candle power is apt to be low, so that we put steam into the wash box, condenser and scrubber and heat them up, so that the gas first coming over would not have to give up its heat to heat the water and those chambers, and we find it a slight benefit. That test of the tar in the seal pot, as to whether you are running too high or too low heats, is only an approximate one. Sometimes if you are running very high heats you will have chunks of carbon in the seal pot, and if you are running too low altogether you will have tar on the surface of the seal pot; but it is merely a rough indication. Concerning the test of the candle power on the generating floor by the gas maker, the Edgerton standard lends itself to a very quick test, and when it is regulated it does not take more than one or two minutes to take a test, so that in from six to seven or eight-minute blows and eight-minute runs it is a comparatively easy matter for the gas maker to find time to take a test. Have I answered Mr. Humphreys' questions?

Mr. J. J. Humphreys, Jr.—One that Mr. Leonard has not answered, is why is it not just as economical to make runs throughout the day more nearly average by cleaning a little oftener, instead of making 19,000 at the beginning, when the set is in its best condition, and 10,000 at its worst?

Mr. Leonard—Well, I think that probably where you clean oftener the coal per 1,000 is apt to be a little higher, and if you are able to measure your make per run and how fast it is falling you are able to cut your oil, and you get about as good oil results when the make is low as when you first start up and it is high. So that the advantage of running as long as you can is that it takes less labor to clean, and I think you get a little better coal results; and also, where we are running sometimes, as we do, full, we don't want to make more than two cleans a day if we can help it. That is, when running twenty-four hours the fire would be cleaned once in twelve hours. In the summer

time we probably will run twelve hours, say, or a little more, before cleaning. That length of running lends itself to easier working with regard to cleaning fire and labor.

The President—Mr. Africa, we would like to hear from you.

Mr. Africa—I think Mr. Leonard has covered the work very well. I would like to ask him how much candle power per gallon does he get? I ask this question in order to show to the members that this method of running will produce good results.

Mr. Leonard—The candle power per gallon of oil used will vary considerably in the summer time. I think our best results are something like 6.33. In winter time they drop considerably.

The President—Is that gross or net? Do you figure out the tar?

Mr. Leonard—No.

The President—Then it is gross.

Mr. Leonard—That is to say, you take the number of gallons of oil used and divide it by the make corrected, and divide the average candle power by that.

The President—Yes.

Mr. Leonard—Corrected to 60° and 30 inches.

Mr. Africa—I would say that we run in about the same manner, and the oil results in summer are practically the same; in the winter it drops down to between five and six candles to the gallon.

The Secretary—Does Mr. Africa use the steam connection on top of his superheater?

Mr. Africa—No. We removed about half the brick in the superheater, so that we do not get too much heat in it. It answers the same purpose as cooling down what brick you have there. We have an old style apparatus, and the superheater is about 30 feet high, so we had too many brick for the size of balance of the apparatus. By reducing the number we finally got the right proportion of brick, so that the whole apparatus gets the right heat at the same time. When we finish the blowing, the fire, carburetor and superheater are all in the proper condition, so that we do not need to use the steam; but

I should think it would be a very good idea to have that connection.

Mr. Addicks—I should like to ask Mr. Africa, first, whether he uses a relief holder; second, what his average candle power is?

Mr. Africa—We use a relief holder. The average candle power is from twenty-six to twenty-eight.

Mr. Barnum—What does Mr. Africa use in testing the candle power?

Mr. Africa—An ordinary eight-foot lava tip.

Mr. Addicks—I should like to ask, to make it complete, first, as to whether the bar is at the works or a mile or more therefrom, and whether the test is taken at both of such locations?

Mr. Africa—The bar photometer is at the works. We also have a bar at the office, which is one and one-half miles away; but as we make a mixed gas the candle power taken at the office uptown would not affect the water gas results. The candle power is taken a number of times a day with a pentane standard lamp.

Mr. McKay—Mr. President, this paper of Mr. Leonard's is a thoroughly practical one, full ot sensible observations very concisely stated. It ought to be of a great deal of help to people who are taking up this work, and the last bulwarks that have been opposed to water gas in New England are falling fast. I was surprised, however, to learn that in making gas with the double superheater apparatus Mr. Leonard finds that the highest heat is at the top of the carburetor, and that he subjects the oil vapors and water gas to a constantly diminishing heat. We certainly don't have the highest heat at the top of the carburetor. Taking the heat at the top of the carburetor as one condition, the bottom of the carburetor is hotter than that, the bottom of the superheater is hotter than the bottom of the carburetor; part way up the superheater is the hottest of all; perhaps one-third the way up the superheater. To overcome the difficulty he mentioned, about laying up the brick in the top of the superheater so as to use a sight-cock to tell the heats, we put in another sight-cock about four feet lower down, so that we can tell the condition of the heat at that point, no matter how the bricks are laid. We found it was desirable to

cease the checkerwork where the dome of the superheater begins to come in, so that the gas should be subjected to no restriction while it was taking up this large amount of heat. One thing to be considered with respect to feeding oil in on the carburetor, especially where the top of the carburetor is the hottest in the apparatus, is the temperature of the oil as it flows in. If there is a very large difference in temperature between that oil and the bricks, it would seem as though it must affect the decomposition of the oil unfavorably. Perhaps Mr. Leonard can tell us at about what temperature the oil enters the carburetor. And with respect to the take-off pipe from this apparatus, which he mentions as not clogging up, I would like to know what the diameter of it is, and what amount in cross section is used up by the oil heater pipe that he uses. In other words, how much net free outlet from the machine is there, and what is the back pressure from his relief holder? I notice he tests the gas taken from the relief holder on a bar photometer in the generating room. As I understand it, that gas has not been thoroughly condensed, perhaps has not been scrubbed at all; it probably carries a reasonable amount of tarry vapors that are later thrown down. The test is made on an Edgerton standard, the chimney of which must suffer more or less from condensation of water vapor, and as it is in the generator house there must be a deposition of ash, which would impair the relation of those tests to a bar photometer. I notice he still uses the soap brick in the carburetor. As the soap brick per volume of material is much more expensive than the ordinary square brick, I wonder if Mr. Leonard can tell us whether the advantage in the continued use of the soap brick repays him for the advance in price he has to pay for that form of brick. He speaks of getting down heats in the superheater by the use of two one-inch steam pipes. Are those wide open when in use, and what pressure is the steam under that is admitted to the apparatus, and how long a time does he ever have to use those? It seems an enormous volume of steam if it is allowed to go in freely. We formerly used steam for a little while, but in a very small amount, in bottom of superheater while on blast, as we found that with gas oil the heats were raised quite high by the combustion of some of the residue from the gas oil. We found, however, that it was easier to regulate the heat by the time of the blow and run. By varying that we reached a

point where the combustion of this oil residue from the gas oil would leave the apparatus (when ready to make gas) at just a right heat, so that we lost no steam and wasted no blast. He speaks of cutting down the opening of the generator blast valve. Our experience with that method of regulating the blast was less satisfactory than it was to leave the generator blast always full open, and to vary the pressure of the air in the main blast pipes. Referring to Fig. 1 there is a very large decrease in the make per run, from something like 18,000 down to 10,000. Perhaps one reason for the rapid decrease in the make is in the condition of the material in the generator. He speaks of the runs being eight-minute runs where he is heating 1,200 pounds of anthracite coal each four runs. How long are the blows corresponding to that? Are they variable, or are they a fixed time? This use of an up-and-down run we found left the apparatus somewhat too cold. In fact, there are a number of points through the paper that seem to indicate that the fixing surface is large for the gas made on the generator, and this up-and-down run would keep down the make on the generator thereby making that fixing surface relatively even greater. With respect to the 70 minutes for cleaning the fire, does that mean from the time the set is shut down till it begins to make gas again, or does it cover the time of pulling out ashes and coaling up? I don't exactly see why the candle power suffers when the set starts up after lying idle for a while. Certainly if the set is in the right condition for making gas, the gas leaving the apparatus ought to be just the same then as at any other time, and if it is chilled or cooled I can't see why it suffers more at this time than at another if it is always a fixed gas. With respect to brushing the bricks taken from the fixing chambers: Is that which is brushed off ash, dry carbon, or other material? Does it pay to put back any old brick? The paragraph with respect to the valves on the apparatus might invite the comment that particular attention should be paid to the water cooled, hot valves. If these are not kept tight the advantage of the up-and-down steam service is less; they should be kept tight and frequently examined to remove the ash, and to see if the disks set tightly against the faces. Such an examination, while involving a little expense, amply repays for the work in the extra service that the generator will give.

Mr. Leonard—The take-off pipe, as I remember it, is about

sixteen inches in diameter, and the oil heater is made up of four lengths of extra heavy one-inch pipe. I have not the temperature of the oil as it comes from the heater, but if you put your hand on the outside of the oil pipe it would be altogether too hot to leave it there. The back pressure of the relief holder is about four inches. Regarding the taking of the candle power on the Edgerton standard. It is quite hot on the floor in the summer time; the temperature will run up to 80°, possibly a little higher, and of course that will vitiate candle power results; but in order to overcome that we also take the candle power on the outlet of the main holder every hour with an Edgerton standard, so that the candle power as taken on the floor is merely a convenient index of the gas that we are making to enable the gas maker to tell whether to increase the oil or diminish it in order to keep the candle power in the large holder steady. In regard to renewing the bricks in the carburetor and superheater, I have no figures as to the relative cost ot the soap brick; in fact, we use soap brick in the carburetor and the larger brick in the superheater. As to putting the steam to cool down the carburetor and superheater, it is done usually, when we have to do it, say once in three or four runs, and we leave the steam on for possibly three or four minutes during the blow. Sometimes we have to use it at both the bottom of the superheater and at the middle, but usually at the middle of the superheater is enough.

Mr. McKay—A one-inch pipe, wide open?

Mr. Leonard—Yes.

Mr. McKay—What pressure of steam?

Mr. Leonard—About 100 pounds. I might modify that by saying sometimes it is wide open and sometimes not, depending on how high it is. If the superheater gets too hot and we want to get it down quick we let it wide open. The gas maker uses his judgment about that. In regard to blowing, we use eight-minute runs and the blow is variable; that is to say, sometimes it might be six minutes and sometimes seven or nine; possibly ten, occasionally. We try, however, to make them as uniform as possible, usually about seven minutes. As to the time required to clean, 70 minutes is the time required from the time of starting to the time of beginning to blast again; it is not the time up to the time at which we begin to make gas again. But

the first blow generally occupies, at different times in the year, from fifteen to twenty-five minutes. In regard to the question of dropping the candle power when we start up after a machine has lain idle for several hours, sometimes we find that it is a little bit difficult in starting up to get candle power immediately, and this heating of the apparatus helps a little. Why that should be so I have not investigated very thoroughly. In brushing off the bricks we use steel wire brushes, and we also use a steel scraper made of an ordinary file, say three-fourths of an inch wide, sharpened at the ends. The steel wire brush takes off the loose ash, which is not stuck very hard to the brick, and then the steel scraper takes off an incrustation of carbon. As to whether or not it pays to put the bricks back, I can only say we do it.

Mr. Anderson—Mr. President, I should like to ask, in relation to the blower pressure on the set, what Mr. Leonard considers that should be; whether it should be twelve or sixteen on a clean set. I am speaking of a set that is apparently clean and new.

Mr. Leonard—Well, I think the best way to judge the pressure on a set is by the differential gauge. We use sixteen inches at the bottom of the generator, and the differential gauge shows from eight to nine inches, but I think there is a tendency to get down to five and six differential gauge, and better results are claimed. But we tried it and went back to a nine-inch differential, because we got a bigger make and the men were more used to it.

The Secretary—I would like to ask Mr. McKay if he referred to a Lowe set of the double superheater type in his remarks, in regard to the heats.

Mr. McKay—Yes.

The Secretary—And I would like to ask if either Mr. McKay or Mr. Leonard can tell me the effect on the amount of combustible gas from the generator in the blow by the variation of blast pressure on the generator; that is how varying the blast pressure affects the amount of combustible gas which is available for heating the brickwork.

Mr. Leonard—You mean if you open the generator valve wide rather than partially open it?

The Secretary—Yes; of course that in effect increases the pressure within limits.

Mr. Leonard—If the generator blast valve is open wide, under your normal blast pressure you will get a certain volume of blast gases going up through the top of the generator. Now, if you diminish the opening of the generator blast valve that volume is diminished; how much I don't know. Cutting down the opening of the generator blast valve has about the same effect, I should suppose, as reducing the blast pressure on the engine. But if you are running two or three machines together it might be desirable not to diminish the total volume of the air going to the sets, and the suggestion in the paper, that it might be well to cut down the opening of the generator blast valve rather than cut down the speed of the engine, was merely a suggestion that it could be done that way where you have more than one machine in operation at the same time.

Mr. McKay—With a fixed opening in the generator for the blast, an increase in the blast pressure will have one of two results. 1st. If the air supply to the carburetor and superheater is changed so that the gases from the generator are burned in the fixing chambers, the heats will rise. 2d. If the air supply to carburetor and superheater remains fixed the increased blast pressure will carry more combustible gases from the generator into the atmosphere. There is another condition sometimes found; increasing the air supply to carburetor and superheater beyond the amount needed for combustion cools off one or both of these fixing chambers.

The Secretary—Mr. President, I think the gentleman did not quite grasp my meaning. I want to get at the amount of combustible gas coming from the generator with a high blast or a low blast.

Mr. McKay—It would be much more with the high blast. If you open the valves in the carburetor and superheater more and admit more secondary air so as to burn the gases all up in the set, this will raise the heats. Increasing the blast pressure with a fixed opening would certainly increase the amount of combustible gases from the generator.

The Secretary—Another question I wanted to ask, was in connection with the spray. I did not hear whether it was brought out in the use of the Collins' spray, when the spray is

being worked hard, for instance when you are forcing in considerable oil and are obliged to raise the disk a little from its seat in order to get the oil in, are you still maintaining the form of spray which you desire? If any gentleman can enlighten me upon that I should be pleased.

Mr. Africa—Mr. President, as an experiment we had one of the Collins' sprays attached outside of the carburetor, and forced water through it, setting it at various points. We found by raising the disk slightly it was possible to get the regular umbrella shape of spray, with a center spray going down through the middle of it, so in this position it will distribute the oil evenly over the top of the carburetor. If the checker-brick in the carburetor are too close to the nozzle of the oil spray, you will not get an even distribution of the oil. Forcing the oil in under too great a pressure has a tendency to throw the oil against the sides of the carburetor.

Mr. A. B. Slater, Jr.—I would like to hear something about the heating of the oil. I believe a question was asked regarding that, but I have not heard the answer. If I recollect the question, it was as to the temperature of the oil on entering the carburetor. I have tried from the cold oil direct from the tank, up to a temperature of about 600° F., and I finally concluded that after heating the oil up to about 200°, the gain beyond that was comparatively small, not worth the trouble of carrying it further. But when heating the oil by the gases coming from the superheater, as is commonly done, when you first begin to make gas on a run the heater is not very hot and your oil will go in to the carburetor at a comparatively low temperature to begin with, and then increase as your circulation of gas goes through your take-off pipe, and finally, toward the middle and latter part of the run, the entering oil would be very hot, so it goes in as a pretty hot vapor. But I believe that by heating the oil up to 200° we are able to get just as good practical results, as far as fuel and candle power relation are concerned, from the same oil as we were when we carried the heating further. In starting up, making the first run, the gentleman spoke of getting low candle power at that time, and it seems to me that that would be most apt to be caused by not fixing his oil sufficiently, not having his set hot enough for the amount of gas he starts in to make, or rather, putting in too

much oil for the first heat, so that, as the gas goes over and through his seal pot, if he has tar there, it will absorb quite a lot of the heavier vapors, and then, after a set has run a while, so that tar has warmed up considerably, the absorption would be less, and the set being hotter would more effectually fix his vapors, so that he would not lose so much in the seal pot by absorption.

The Secretary—Mr. President, this may be a little bit aside, but still it is nearly in line. I would like to ask for an expression of opinion as to the relative value of coke and anthracite in the generator.

The President—You have heard the question, gentlemen. Who will answer it?

Mr. Barnum—Mr. President, I have figures in regard to that (I have not all that I have taken here) figured on the combustible, and the way we figure it is this. The amount of combustible charged is figured thus: The cinders from the generator we threw over a screen; half-inch holes. The combustible left in the cinders from the front of the screen was taken from the amount charged. The combustible per 1,000 was, for coal, 27.4; for coke, 28.8. That was with an old machine. With a newer machine, if I remember rightly, I think it was twenty-five and twenty-six, with the credit still on the coal side, being one pound less of coal than of coke per 1,000 feet of gas. Taking the amount of fuel charged and fuel recovered and credited in the same manner, on the same basis, there were twenty-eight and twenty-nine pounds, this being in favor of the coal again, and within one pound in each case.

Mr. Addicks—I would like to ask the last speaker as to whether in going from coal to coke the capacity of the machine for making gas in a given time was increased or decreased.

Mr. Barnum—I can't answer that question directly. In regard to the two tests, one was taken one week; say this week we ran the coke test, then we changed and ran three weeks on coal, and then took the test of coal. That is the way I remember it. Perhaps Mr. Humphreys can tell you that.

Mr. Addicks—I don't want it in actual figures, but merely in a general way. For instance, your machine could be counted on in twelve hours for 500,000 cubic feet with coal; how much could it be counted on when using coke?

Mr. Barnum—The machine gained about sixteen per cent. on capacity when using coal.

Mr. Addicks—That has been our experience, and I wanted to see whether it was confirmed.

The Secretary—In moving a vote of thanks to Mr. Leonard for his paper I would call attention to the fact, which I presume you have noticed, that nearly all of the authors of papers this year are men who have not frequently appeared here as authors of papers. I want especially to thank Mr. Leonard, but I also want to call attention to the matter of questioning. Some of us young men, who are rather diffident sometimes, may object a little to being questioned. I recollect that one of our past presidents turned over to me a letter from a member of the Association, saying he thought the welfare of the Association demanded that the practice of questioning authors be abolished. I decidedly object to this practice being suppressed, because I think a good deal of valuable information has been brought out by these questions. Even if some of them seemed a little pointed, I want to encourage Mr. Leonard to think that by answering the questions he has done the Association and the members a great service. Personally and officially I wish to thank him.

Mr. Addicks—Mr. President, I am sorry I did not have the opportunity to move this vote of thanks, but I should like to second it. I know the incident to which the Secretary refers, and I don't think that Mr. Leonard or any of the gentlemen who have read papers here could have a better compliment than to have all these questions put to them. I wish to say that I not only congratulate Mr. Leonard on his paper, but also to congratulate him upon the way in which he handled himself and the questions, and to further say that I take a certain pride in the way Mr. Leonard carried out his tasks, as he was formerly connected with the Boston Gas Company. [The vote of thanks was adopted.]

Mr. Charles F. Prichard read the following

Report from Committee on President's Address:

To the Members of the New England Association of Gas Engineers: The committee to whom was referred the President's address, would respectfully report as follows:

While making no specific recommendations, the President has touched upon many topics prominently before the gas engineers of to-day, and the committee would recommend to the members of the Association a careful consideration of the matter treated.

The committee have noted the valuable information given, especially regarding electrolysis, Texas oil and gas pressures, and for the Association desire to express to the President their appreciation of the work and research involved.

It is with sincere regret that the committee learn that the Association is to be favored with but one President's address from the present incumbent, who has proved himself to be possessed of so able a hand and so clear a mind.

The committee desire to express the hope that the address of the President, together with proceedings of the meeting, be sent to the members in printed form.

CHAS. F. PRICHARD,
SAML. J. FOWLER,
WM. H. SNOW,
Committee.

On motion of Mr. Nettleton, the report was received and adopted.

The President introduced Mr. A. B. Slater, Jr., of Boston, Mass., who read the following paper on

Coal Gas Treatment.

What I have to present for your discussion does not aspire to the dignity of a formal paper, but rather a short topic to draw out the results of various methods practised in the treatment of coal gas, and with special reference to the deposition of naphthaline. Among European gas works there appears to be a fair degree of uniformity in the methods of treating crude coal gas, but in this country methods vary very widely; and particularly in some of the older, small works do we often find that the gas on reaching the consumer delivers to him a fair amount of light and heat per cubic foot, but at an excessive cost to the producer, because of incomplete or faulty treatment of the crude gas.

A plant must be extremely small to afford to be without an exhauster, and no works pretend to be without purifiers. As to the other apparatus of various kinds to be found in coal gas plants, undoubtedly the original designers had definite ideas as to what they were intended to do to the gas, but sometimes they are so installed as to receive the gas under totally different conditions than contemplated by the designer; and it is not impossible that there may even be found an installation of excellent apparatus which fails of accomplishing the results of which it is capable, for it does not require a very incompetent or biased operator to permit good apparatus to go wrong.

It is generally admitted that the gas must be "condensed," but while the term should be understood as meaning the liquefaction and removal of undesirable vapors, it is often taken as meaning simply the removal of heat from, or, in other words, cooling the gas. The removal of the heat from the gas is not itself a principal point, but it is incidental, as producing conditions favoring the removal of undesirable components of the crude gas. To determine a method of treating the crude gas, its general composition must be considered, and also the desired composition of the commercial gas.[1]

Besides the desired components, there may also appear in the commercial gas some nitrogen, carbonic acid, aqueous vapor, and even traces of sulphur, because the advantage gained to either consumer or producer would be entirely incommensurate with the cost of their entire removal, especially if the illuminating and heating values of the gas are maintained.

The last hydrogen sulphide and carbonic acid are taken care of by the purifiers, and the free ammonia and remaining ammonium salts are taken care of by the ammonia washer scrubber, so that in the apparatus ahead of that it is the hydrocarbons that are to be particularly looked after. Of those in the crude gas in sufficient quantity to notice, only those of the more complex molecules are solids at normal temperature and pressure. These, therefore, will naturally be the first to condense on cooling the gas, and following these are those that are liquids under ordinary conditions, the principal ones being

1 See Appendix (page 127). For a more detailed list: See A. G. L. A. Proceedings, Vol. II., page 91; also, "Mills' Destructive Distillation;" "Lunge's Tar and Ammonia;" Humphrys' "Chemistry of Illuminating Gas;" and many others.

benzol, amylene, pentane and hexane. Of the normally gaseous illuminants, the olefines are the most valuable, but nevertheless the vapors of liquid hydrocarbons, especially the benzol, are largely relied upon for the real lighting power of the gas. It, therefore, is desirable to have the finished gas carry as much benzol vapor as the temperature conditions of distribution will allow. As we have a mixture of vapors to deal with, it is well to note that the partial tension of each component of a mixture is always less than the amount of its respective vapor tension when alone at the same temperature and pressure. With this qualification, Dalton's law of vapor tension holds practically good for our range of temperatures; that is, in a space already occupied by a gas, a liquid ultimately evaporates to the same extent as in vacuo, the process being merely more slow.

To retain in full relative tension the desirable vapors it is necessary to remove the heavy, tarry matter at as high a temperature as may be after leaving the hydraulic main, because the power of the tar and heavy vapors to absorb the other hydrocarbons increases with the decrease of temperature. To remove the tar without materially reducing the temperature requires some apparatus which will handle the gas at high velocity; as, for example, the Pelouze and Audoin condenser, which removes the tar by friction, and also by taking advantage of its inertia during sudden changes of direction of the gas flow. The same thing is also accomplished by using a fan exhauster as a centrifugal tar extractor. If, however, this apparatus is allowed to receive the gas *too cool*, trouble will be apt to follow from naphthaline, as has been the case in many instances. If much naphthaline is formed by conditions of distillation at high heats, or by allowing the gas too much or too long contact with the hot coke and retort, it will be carried as a vapor, mostly by the hot tar, the benzols, and the aqueous vapor. As the temperature of the tar reduces, it will absorb much naphthaline on liquefying, but also much of the benzols, and as the vapor of the benzol is excessively reduced by scrubbing through the tar films or by too much contact with tarry surfaces, if the tar is not *hot*, the remaining naphthaline vapor passes on at the point of saturation for that temperature, only to be dropped and crystallize at every material reduction of temperature, especially as the drop of temperature reduces the amount of aqueous vapor, whose carrying capacity decreases

more rapidly than its vapor tension. We, therefore, find that under such circumstances the naphthaline will crystallize as a fine mist, and be often carried long distances, being rapidly collected by any obstruction, sudden change of direction, or even rough spot on the interior of the pipe. In the works and distribution this will be noticed at every point affecting the aqueous vapor tension; for instance, the effect of warm days on the gas in the holder, retaining the naphthaline with the gas, when it will crystallize in the cool of the evening on following the pipes, a fairly rapid circulation carrying it to the services and depositing it, even in those having slow flow from a main in which the velocity is fairly high. It is necessary, therefore, that the tar be removed as hot as possible, thereby avoiding excessive reduction of the illuminating vapors. After removing the tar the gas then contains more or less soot, and the vapors of heavy oils, which may be allowed to agglomerate during slow reduction of temperature, as the resulting liquids will take in solution much of the naphthaline without undue absorption of desirable illuminants. If, therefore, at this point the aqueous vapor is at a minimum, the naphthaline will also be reduced to the amount carried by the benzol, and as benzol is a very good solvent for naphthaline, it will rarely be the case beyond this point that any naphthaline will be deposited, unless conditions are such that some benzol is also condensed, and in that event it will dissolve and carry the naphthaline until the benzol is allowed to evaporate to the air, when the naphthaline may be left behind, as is sometimes seen on leaky holders.

In 1884, at the South works of the Providence Gas Company, subsequently operated by the writer, was installed a P. and A. condenser, that being at a time when the P. and A. was often condemned, and it was by a long series of experiments that the naphthaline subject was gradually developed, so that finally it became possible at will to cause naphthaline to appear in the distribution, or at specified points in the works themselves, and this control finally made possible the avoidance of the naphthaline trouble almost entirely, an instance of it being particularly noticeable at a time when the West works, for reason probably accidental but unknown to the writer, were averaging for several weeks over 100 calls a day for bad lights found to be due to crystals, while the South works, sending out over one-third the amount of gas, through proportionately

longer mains, at the same time averaged less than two calls, although both works were using the same kind and condition of coal distilled in the same kind of setting.

The P. and A. condenser is referred to simply as a type, and not as the only suitable apparatus, although any apparatus which may add aqueous vapor to the gas is not, in my belief, as desirable; for, as will be understood from the foregoing, it is very desirable to keep the aqueous vapor at the lowest practicable point until the naphthaline has been reduced to that proportion which the benzol alone can easily carry.

In cooling the gas the writer has always secured the best results when the heat removed per minute from the same quantity of gas was uniform, or graphically, with ordinates of temperature and abscissae of time the locii of gas temperatures formed a line as nearly straight as practicable.

In practice it is found that the best results are attained by slow cooling, as the heat receiver need then have its initial temperature but little below that of the cooled gas and undesirable reactions are avoided. This calls for low velocity for the gas, and consequently large areas of passages, but if the operation be divided, using an air cooler for the first and water cooler for the second part, the desired uniformity of rate of cooling may be attained with but a small quantity of water, although an analysis of the heat transference shows that the form of water cooler should vary considerably from the usual pattern, the number or area of the tubes being much greater per 1,000 cubic feet, and the tubes being very much shorter.

If, then, the heavy vapors are removed in the air cooler, and the gas contains a minimum of aqueous vapor, insuring a minimum of naphthaline, it may be washed with strong ammoniacal liquor before entering the water cooler, a part of the remaining heat in the gas serving to free some of the ammonia which will react with many of the impurities of the gas forming soluble ammonium salts, and thereby greatly relieve the purifiers. It is important that the velocity of the gas be low and that the ammonia be in excess, as otherwise some of the desired reactions would be difficult to develop without having the temperature below what would be sufficient to liberate sufficient ammonia gas from the liquor. Although this method increases somewhat the work of the ammonia scrubber, the advantage at the purifiers

more than counterbalances it. If this be done, it should be immediately followed by reduction of the temperature in the water cooler sufficiently to prevent increasing the aqueous vapor in the ammonia scrubber or the carrying of any taken up during the washing by the ammoniacal liquor, and in any event the gas might well be cooled to as low a temperature as it will meet in the distributing system, although it must not be too cool while passing through the purifiers, as low temperature would interfere with the action of the oxide.

Some further deductions from the foregoing are: Carry fairly high heats to properly utilize the producing capacity of the retorts, but charge heavily also for the same reason and also to reduce the gas space above the coke, thereby increasing the velocity of the gas leaving the retort, so as to prevent the gas being cracked through overheating by too long contact with the hot coke and retort. Connections from retort to hydraulic main should be as straight as possible and of liberal size. Very short connections facilitate the carrying over of fixed carbon to the hydraulic main where it will be caught by the heavy tar, and if allowed to stand will tend to form a thick paste or even a sort of concrete, while on the other hand too long connections may apparently favor the hydraulic main but with corresponding increased tendency for the pipes to stop up. Keep in motion the tar in the hydraulic main and remove it as fast as possible to prevent its accumulating the fixed carbon, which, as it comes over from the retort, if allowed to accumulate, is usually responsible for the troubles commonly said to be due to the hydraulic being too warm and pitching the tar.

As a matter of fact, the hydraulic should be guarded, especially in cold weather, from any cold wind, as the effect of the chill would certainly be to increase the viscosity of the tar and interfere with its removal. The seal in the hydraulic is preferably maintained by using gas liquor and not cold fresh water, which would chill the tar and absorb a very appreciable quantity of the gas if used in excess, while the gas liquor would not act as an absorbent, to any extent, of any of the desirable components of the gas, but would tend to somewhat increase the relative amount of free ammonia, thereby favoring subsequent treatment.

Principal Components of Crude Coal Gas.—Temperatures are given in Centigrade.

Name.	Symbol.	Normal State.	Boiling Point.	Specific Gravity.	Cu. Ft. Per lb.	Solubility in Water.	Luminosity of Flame.
Hydrogen.	H_2	Gas		.0693	188.42	.0193 to 1	Slight blue.
Marsh gas (methane).	CH_4	Gas	—164°	.556	23.55	Small	Very slight.
Other paraffines (incl. butane).	$C_nH_{2n}+2$	Gases	Below 2°	1.000 to 2.000		Very small	Increases with carbon but in less ratio.
Pentane.	C_5H_{12}	Liquid	38°	*2.489	5.29	Almost insol.	As last above.
Hexane.	C_6H_{14}	"	68°	*2.975		" "	" "
Heptane.	C_7H_{16}	"	98°	*3.465		" "	" "
Ethylene (olefiant gas).	C_2H_4	Gas	—102.5°	.968	13.46	.16 to 1	Very good.
Propene.	C_3H_6	"	—61.°	1.498	8.8	Small	" "
Butene.	C_4H_8	"	—5.°	1.936	6.8	"	" "
Amylene.	C_5H_{10}	Liquid	35°	*2.419	5.45	Very small	" "
Amines (mostly methyl).	$(C_2H_4)nNH_3$	Gases	0°	1.073	10.±	Very soluble	Fairly good.
Acetylene.	C_2H_2	Gas	—85°	.920	14.48	1 to 1	Very fine.
Benzol.	C_6H_6	Liquid	80.4°	*2.695	4.88	Almost insol.	" "
Other benzols.	$C_nH_{2n}—6$	"	111 to 230°			" "	Very good.
Toluene.	$C_6H_5CH_3$	"	111°	*3.179	4.14	" "	" "
Naphthaline.	$C_{10}H_8$	Solid	218°	*4 423	2.98	Insoluble	Quite good.
Diphenyl.	$C_{12}H_{10}$	"	254°	*5.33			" "
Anthracene.	$C_{14}H_{10}$	"	360°	*6.18			" "
Pyrene.	$C_{16}H_{10}$	"	Very high	*6.98		Similar to	Naphthaline.
Chrysene.	$C_{18}H_{10}$	"	" "	*7.82		"	"
Carbonic oxide.	CO	Gas	—193°	.967	13.46	Nearly insol.	Practically none.
Carbonic acid.	CO_2	"	—78°	1.527	8.56	.975 to 1	Incombustible.
Carbon disulphide.	CS_2	Liquid	47°	*2.645	4.95	Nearly insol.	Blue.
Hydrogen sulphide.	H_2S	Gas	—62°	1.191	11.09	3.17 to 1	"
Nitrogen.	N_2	"	—193°	.971	13.46	.15 to 1	No flame.
Oxygen.	O_2	"	—181.4°	1.105	11.77	.029 to 1	" "
Aqueous vapor.	H_2O	Liquid	100°	.622	20.93		" "
Ammonia.	NH_3	Gas	--33°	.590	22.17	712 to 1	Slight blue.

Ammonium.
Cyanides.
Carbonates.
Sulphides, etc.
Heavy tar vapors.

*Vapor.

DESIRABLE COMPONENTS OF COMMERCIAL COAL GAS. } Hydrogen. Paraffine series, up to hexane. Olefine series up to amylene. Acetylene. Benzols. Carbonic oxide.

MEMORANDA.

Propene.—Small quantity in the crude gas.

Butine.—Considerable quantity.

Amines.—Extremely soluble in H_2O.

Easily decomposed by heat $= 6H_4 + NH_3 + HCN + H_2$. Contain ammonia.

Acetylene.—Not very soluble in coal tar.

Benzol.—Decomposed by heat to diphenyl and hydrogen.

Diphenyl.—Is formed by overheating benzol vapor yielding about fifty per cent. Boils at 254°.

Naphthaline—Formed at high heat. Produced by overheating toluene, a mixture of ethylene and benzol, anthracene or chrysene, ethylene alone, acetylene, or a mixture of acetylene and benzol.

Properties.—Melting point 79°. Monoclinic tables, insoluble in cold and nearly insoluble in hot water, very soluble in alcohol, ether, benzol and essential oils, also acetic acid. It is volatile with steam; one part distilling with about 570 parts water. It burns with smoky flame. When overheated yields methane and dinapthyl. When overheated with aqueous vapor is mainly unaltered, but yields some acetylene and benzol; but with acetylene yields much anthracene. It is usually four per cent. to six per cent. and sometimes even ten per cent. (by weight) of coal tar, being about the same in by-product coke oven tar as in retort gas tar, and being found in the light oils distilling, at from 180° to 250°, most abundantly in the carbolic oils. In general the solubility of naphthaline in tar oils increases to a certain limit with the temperature. Sp. gr.; solid, 1.1517; liquid, 0.97. The tension of aqueous vapor at 59° F. (about 16° C.) is one-half inch of mercury; say, about one-fourth pound per square inch.

The President—Mr. Prichard, we would like to hear from you on this subject.

Mr. Prichard—Mr. President, I had much rather hear from some one else and come in later myself, but I suppose I have to do as you say. I am very much interested in Mr. Slater's

paper, and I imagine I read it over at least a dozen times, because the first year of the last two I was engaged in planning a plant to accomplish something like what he has described, and for the last year have been operating this plant when completed. The stress that he lays on the various points is very fully borne out by my experience. We have this question of gas handling coming constantly before us. It reminds me of the old saying about advertising, that it was necessary for a man to advertise about a million times before the general public get it into their heads at all that the thing was being spoken of. And so it is with this gas handling apparatus. In 1867 Dr. Bowditch published a book on "Condensation," which was one of the best things that ever was written; and from that time down to the present we have been having articles just along this same line, and we have not yet got it knocked into our heads. I imagine that fifty per cent. of the plants running to-day are robbing their gas by means of tar that is cold, and tar that is lukewarm, and we don't seem to rise to the thing at all. It is a very great benefit to this Association to have this matter brought up by Mr. Slater and have it very fully discussed. Regarding the P. and A. condenser, I don't know whether I made a mistake in not putting one in or not, but as he read the paper, and as I looked it through, there was one point on which I would like to ask him a question, which is whether he made any tests of the aqueous vapor before and after the P. and A. condenser. The inference that I draw from the paper is that the P. and A. has diminished the quantity of aqueous vapor held by the crude gas. If Mr. Slater has made any tests on that I should be glad to hear from him.

Mr. A. B. Slater, Jr.—I have made some tests in regard thereto, and find that is, as would naturally be expected, a matter depending almost entirely on temperatures. If the gas is taken to the P. and A. very warm, the reduction in the amount of aqueous vapor is very small; but if it is cooler (say if it is taken to the P. and A. at a temperature of 120° F.), the amount of aqueous vapor before and after passing the P. and A. would vary a little. But if the gas goes in at a temperature of 90°, the total amount of aqueous vapor will be less when it reaches there, but the reduction of aqueous vapor in the P. and A. will be proportionately more.

Mr. Prichard—I want to say, Mr. President, following my

starting point, that during the past two years we have put up a gas-handling plant, as I call it, which seems to work very nicely. We take the gas, first, from the hydraulic mains to the exhauster, then from the exhauster to a three-section Walker tar extractor—in other words, three immersions. Gas enters that tar extractor at somewhat varying temperatures; we will say 115° to 120°. It passes from the tar extractor to the water condensers; from there to the standard scrubber; and from there to a set of four boxes, seven feet deep by twenty-four feet square. We attempt to keep the temperature in the tar extractor from 115° to 90°. Then it goes into the condenser, where is it cooled down to about 65°, and then passes on to the standard scrubber where the ammonia is taken out. Then it is reheated and put into the boxes at a temperature of about 70°, in the first box, and allowed to cool down, as it passes through the various boxes, till it gets to about 65°, when it is measured in the station meter. Now, I suppose all of us, at one time or another, have had the opportunity to go through our works and see the vast amount of tar that we can find almost anywhere in the plant, from the exhauster to the purifiers. I suppose almost every man here, at some time or other, has taken down his purifying connections and found them half full of tar. If that tar was there, and it is there (I think you will all agree with me that you have found it there time and time again), and if the effects on tar are, as Mr. Slater states, and I thoroughly agree with him, it seems to me it will explain to all of us how much we have been robbing our stockholders and our dividends. In our own case, the change in the last year, and we have just finished one complete year, in producing the same number of candle feet this last year that we produced a year before, we made a saving in hard cold cash outlay of $5,600, and it is mostly due to keeping cold or lukewarm tar from contact with good gas.

Mr. Addicks—Mr. President, I would like to ask Mr. Slater if I have gotten a correct impression from the reading of his little classic that, while napthaline is absorbed by the hot tar, the aqueous vapor and the benzole, he means to have us understand that that portion of the naphthaline which is held in solution (if I may use that expression) by the benzole is the portion that may safely be taken to the burner?

Mr. A. B. Slater, Jr.—The naphthaline which may be safely

left to go to the consumer's burner is that proportion which can be carried by the benzole alone through the varying conditions of distribution. I think on that point, too, there is a very strange idea amongst a great many gas men that they must not cool their gas below 60°. They seem to have an idea somehow that 60° is some sort of standard that must be maintained as the proper temperature to which to bring the gas at the works, and that is all there is about it. But while 60° is a good temperature at which to measure the gas, and is also a good temperature at which to remove the ammonia, still at that temperature there will be held in suspension by the gas certain vapors. If the temperature is very much reduced, as is often the case in distributing systems—for instance, where the gas is subjected to (in some cities) 10° below zero perhaps—there certainly some of those vapors must be condensed at that low temperature which would not be condensed at 60°, and if they are condensed at that low temperature it seems to me it would be useless to send them into the distributing system and have them condensed there, where they have to be pumped out and carried back to the works, to be used for carburetting water gas, or, as is very often the case, thrown away. That is why I say the gas might well be cooled to as low a temperature as it would meet in the distributing system, because if you cool the gas to a certain temperature it makes little difference whether it is done in the works or in the distributing system, for you will cause the condensation of certain vapors, excepting that when cooled down to that point in the works before the final purification of the gas, the condensation of some of those vapors will be affected by the condensation of others, if their boiling points are near each other. It is a fact that if there are two vapors in the gas, one of which has a slightly lower boiling point than the other, if the gas is very quickly cooled, so that the one with the highest boiling point is condensed, it will in its condensation bring down more of the second vapor than would normally come down at the same temperature and pressure.

Mr. Addicks—May I just add a further question, so as not to lose the thread? I would like to ask Mr. Slater, if we assume for the moment the desirable quantity of benzole, I mean by that under a normally made coal gas of normal candle power, and then assume that the naphthaline in solution is,

we will say, a saturate solution for that benzole under those conditions, the whole forming a desirable gas to put at the burner, how low does he think the temperature of that gas can go without depositing the naphthaline as a solid disassociated from the benzole; I mean in degrees F.

Mr. A. B. Slater, Jr.—If you assume a gas to have a normal amount of benzole, say about one per cent, and that benzole is carrying its *full complement* of naphthaline, that being at normal temperature, say about 60°, and at the usual pressure, perhaps a couple of inches, then just as the temperature is reduced the power of that benzole to carry naphthaline is reduced—that is, the cooler the benzole the less able it is to hold naphthaline in solution. So that if you cool the gas ever so little there will be proportionately some tendency for that benzole to drop a little naphthaline.

Mr. Addicks—But will it drop out of the gas even then entirely? Will it be deposited?

Mr. A. B. Slater, Jr.—That will depend on whether the other vapors in the gas are able to carry it. If there is anything else in the gas that can carry it when the benzole lets go of it, that distribution will take place in the gas without change of temperature. I can hardly suppose a case wherein the vapor of benzole in the gas would carry a full complement of naphthaline and the other vapors in the gas not carry theirs. That distribution I think would unquestionably take place, so that the various vapors would each have their relative proportion of naphthaline to carry. In order to suppose that the benzole carries its full complement, we must suppose that all the other vapors carry their proportionate complements. If the temperature is reduced the aqueous vapor will be the first to drop what naphthaline it carries and when that goes down then a small proportion will come from that carried by the benzole, and the amount of naphthaline dropped will increase as the temperature reduces, simply because the carrying power of the vapors decreases as the temperature goes down. At just what temperature the amount of naphthaline that is deposited would become troublesome would be pretty difficult to state, because it would be an increasing function as the temperature went down, and just where the point would be reached where no more naphthaline would be carried in suspension I think you would find

rather below any temperature at which we are apt to distribute gas.

Mr. Wood—Mr. President, this paper appeals to me, as it did to Mr. Prichard, and as I think it must to all of you, from the stress which the author puts on a part of the apparatus which is too often neglected; the condensers. It would please me if I could ask Mr. Slater as many questions as were put to our friend from Fall River, but I find that his reasoning and conclusions so correspond to and fit into my own knowledge and belief on this subject, as justified by my own experience, that I can only pat him on the back and say "Amen." The question of condensers has always been more or less of a hobby with me, and I have quite a collection of notes which I had intended to incorporate in a paper to be read to the Association at some future time. Mr. Slater has rendered that unnecessary, and for that I thank him. His paper is so comprehensive that I find little to criticise. The apparatus in a gas works has happily been likened by some one, I have forgotten who, to the human organization, and you can all see, without my enumerating them, which parts correspond to the various parts of the human body. But it is self evident that the condensers constitute the bowels of the gas works. The careful manager, by frequent observation of thermometers, pressure gauges, drips, station meters and holders, can tell whether the conditions are normal and satisfactory. Am I right when I say that the thermometer is too often ignored and neglected? Whether I am right or wrong, you will agree that in the case of the medical practitioner such neglect would class him as careless, to say the least. One statement Mr. Slater makes is that among European gas works there appears to be a fair degree of uniformity in methods of treating crude coal gas. That may be true as to methods and apparatus, but lately I was comparing the description of two German works; probably most of you have seen it. These included a works of large size and one of fairly large size, and it was claimed of the smaller of the two that it was laid out after a careful mathematical and scientific computation for every part of the apparatus. Nothing was taken for granted, and it was supposed to represent the best modern European, or that part of European thought on the subject. After I read Mr. Slater's paper I compared the apparatus in those two works, and find that the arrangement, in line, of

different parts is similar; and there is no disagreement as to methods, so far as that goes. But when it came to areas, there was a wide difference, especially with regard to the atmospheric condensers.

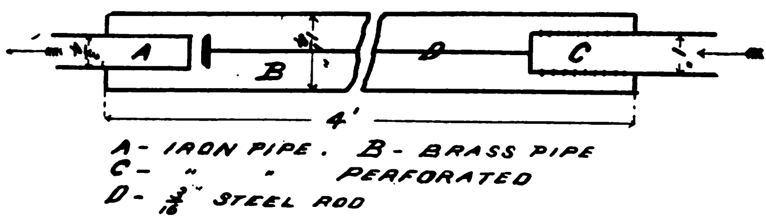
In one works the square feet per 1,000 in twenty-four hours was four and seven-tenths, and in the other seven and one-half, so that there is evidently some disagreement between our European friends, from the theoretic standpoint, in this matter. I think we must all agree with Mr. Slater that the proper arrangement of the apparatus is atmospheric cooling in large areas at slow velocity, followed by friction, or change of direction, or filtration, at a higher velocity, and that followed by water cooling, and such an adjustment of the water cooling that the difference between the entering gas and out-going water will be just enough to do the work and no more, and that that condition shall be maintained throughout the length of the water cooler. Now, that is an ideal condition. It may not always be obtainable, but it can be approximated, and the closer you come to it in my belief the better off you will be. I would like to add one suggestion to that thought, and it refers particularly to the New England climate. Suppose your air condensers were adjusted to take care of your make at midday in the last week in October, and you have a heavy make. The atmospheric temperature may be 80°. Now, if your condensers are adjusted so that your outlet temperature is satisfactory at noon, at midnight the thermometer may be down to 32°. If no change is made in the apparatus the conditions are decidedly wrong, and trouble will follow. That leads to the suggestion that that part of the apparatus preceding the multitubular should be in small units which can be put off or on as occasion demands. One other suggestion I would like to make is in reference to the washing with ammoniacal liquor, and that is that it may be found desirable to cool the liquor as well as maintain the gas at a certain temperature. It is possible that if you are drawing the liquor from a hot well it may be too hot to do good work, and provision should be made for passing it through some cooling apparatus. I have found the water in the holder tank useful for this purpose.

Mr. Prichard—Touching that point Mr. Wood made, I can suggest a wrinkle. We regulate our water going through the multitubular condensers by the outlet. On the outlet we have

an expansion trap, which is made up of a piece of iron pipe and a piece of brass pipe and a piece of a second-hand globe valve. By means of that you can regulate the temperature of the gas coming away from the condensers without going there at midnight, whether cold days or warm days or any other days. It takes care of itself within a very few degrees.

The Secretary—Will Mr. Prichard send in this wrinkle in such form that it may be published in the proceedings of this meeting?

Mr. Prichard—I should be glad to do so, Mr. President. I think you can find them at almost any fitting shop, or they will build one for you. I will make a little sketch of it and put it with these remarks.



Sketch subsequently submitted by Mr. Prichard.

Mr. A. B. Slater, Jr.—I would like to ask Mr. Wood whether in his remark about adjusting the condensers to the variation of temperature he meant to vary the conditions so as to maintain the same temperature for the gas after cooling, or to vary the temperature of the gas after cooling to suit the changed conditions of outside temperature?

Mr. Wood—That is what I had in mind. If the air condensers are proportioned to care for the maximum make of gas in winter, conditions of atmospheric temperature and make may arise at a different season which will render it difficult to maintain a suitable gas temperature at the inlet of the multitubular. In meeting such conditions I have found the subdivision of the air condenser a great advantage.

Mr. A. B. Slater, Jr.—That point is, in European practice, covered to some extent by simply putting the condensers out of doors, so that the gas is affected just in proportion as the outside temperature varies.

Mr. Prichard—Mr. President, I don't want to do all the talking, but the remark that Mr. Slater makes on page 125 regarding the P. and A. condenser and the Walker tar extractor, as representing the two types, is one that interests me very much, because I would like to know if we made a mistake in adopting the Walker instead of the P. and A. It seems to me as though Mr. Slater's opinion of it was based on the fact that the Walker tar extractor, or any immersion extractor, would add aqueous vapor to the apparatus. It was for that reason I asked him if he had made any test of the P. and A. condenser, as to whether that took out aqueous vapor, because I wanted to compare his results with some that I had made myself on aqueous vapor. I find the following to be the fact in our case, that the gas coming from the hydraulic main and passing into the inlet of the tar extractor was saturated with aqueous vapor three times out of four, and practically saturated the fourth time. In either case on the outlet of the tar extractor it was saturated. At the outlet of the condensers it was within four per cent. of saturation, at the outlet of the scrubbers it was saturated, at the outlet of the boxes it was about eighty-five per cent. saturation, and at the outlet of the governor, passing out on to the street, it was about seventy-five per cent. saturation. In another form, of the total aqueous vapor there was in the gas coming from the hydraulic mains, the tar extractor removed thirty-one per cent., the condensers took out fifty per cent., the standard scrubber added three per cent., and the boxes removed one per cent. Now, if the P. and A. condenser, by virtue of the condensing power of small apertures removes any aqueous vapor, it seems to me it has a decided advantage over the Walker tar extractor. The P. and A., as I understand it, has the disadvantage of the slots or apertures clogging up, and it seems to me it also has the disadvantage of keeping the gas in intimate contact with the tar, which, I believe, is a thing we don't desire to do. If, on the other hand, it has a compensating advantage of relieving us of aqueous vapor, then perhaps it is a thing that we ought to adopt rather than the other form. It is along those lines that I am anxious to have the matter discussed.

Mr. A. B. Slater, Jr.—Mr. President, referring to the question as between the P. and A. and the water immersion tar extractor of the Walker type, I would say that the P. and A. reduces the

aqueous vapor very slightly, perhaps not over five per cent., and at the same time with the P. and A. there is very small practical chance of its being increased, whereas with the immersion type of apparatus it can be operated so as to keep your aqueous vapor up, and if your aqueous vapor is not at the point of saturation before it gets there it may be operated so as to make it come up to that point. The objection to the P. and A. has almost invariably been, as Mr. Prichard stated, its liability to clog up and for the tar to take out the illuminants, but from my experience I consider that result to be almost entirely a matter of temperature. There is one thing outside of temperature. If the P. and A. is put close enough to the hydraulic main, and you are distilling coal with light charges and distilling very hard at high heats, you carry over a lot of fixed carbon that goes by the hydraulic main, and your tar in the P. and A. would catch it, then you have a chance of sticking up even at high temperatures; but if the P. and A. is not put near enough to the hydraulic main to catch any of that coarse soot, as I call it, or fixed carbon, then it seems to me from my experience it is a matter of temperature almost altogether, because if the tar is kept hot enough it will flow away. With very hot tar we never have had any trouble at all with the holes sticking up in the P. and A. Of course the power of the tar to absorb the illuminants increases with the decrease of temperature, so that the hotter you can keep that tar the better. For that reason I believe in having the gas go to the P. and A. tar extractor at as high a temperature as may be after taking the gas from the hydraulic main, say put it in at 140°, if you can get it there, because at that temperature the absorption of illuminants would be very small. The tar on condensing there will bring down some naphthaline, but at that temperature it is not apt to bring down any appreciable amount of benzole. And one point there is to let that tar, on condensing at that point, bring down as much of the naphthaline as you can, so as to condense that naphthaline without doing it at the expense of the benzole.

Mr. McKay—Will Mr. Prichard tell us the highest temperature, degrees F., that he has ever found coal gas to be saturated with aqueous vapor? Has Mr. Slater made any experiments on this?

Mr. Prichard—I don't remember the temperatures very closely, but generally we get the gas going into the tar extractor at about 120°, and it is saturated at that point. That is the first place I have ever made any tests on the saturation; but I see no reason why it should not be saturated from the standpipes to this point. The dropping of water is very considerable between the inlet and outlet of the tar extractor, and a very large amount between the outlet of the tar extractor and the outlet of the condenser. I am going to thank Mr. McKay for those tables which he got up several years ago, which I used in this particular case, and they were very good indeed.

Mr. H. C. Slater—In speaking of these temperatures it may be interesting to note that the boiling point of benzole and the melting point of naphthaline are very close together. The boiling point of benzole, I believe, is given as 80.4° C., and the melting point of naphthaline at 79° C.

Mr. D. D. Barnum—In the light of Capt. McKay's paper, entitled "Temperature," and read before the New England Association in 1897, Mr. Slater's paper is very interesting. In looking over the paper I found one or two points which I would like to ask Mr. Slater about. On page two there is this statement: "The olefines are the most valuable." I had always thought that the value of a hydrocarbon constituent depended upon the ratio of the total carbon to the total hydrogen and the carbonic oxide in the mixture. For instance: A mixture with a high percentage of hydrogen would give better results if it had the acetylenes instead of the olefines; and one low in hydrogen, better results if it had paraffines instead of olefines. And if we consider the different groups of hydrocarbons as illuminants to be burned alone, it has been proved that the acetylenes give the highest candle power. In the same paragraph as the above is also found the following: "That the benzoles and other vapors are relied upon largely for the illuminating power." It is seldom that coal gas, after it is condensed, ever contains over 1.2 per cent. of condensable vapors. Mr. A. S. Miller, I believe, has found that they seldom or never exceed two per cent. in thirty-candle power water gas. And it is hardly consistent with known determinations to figure on more than three and one-fourth candles per one per cent.

of vapors in coal gas, and one and one-half candles per one per cent. in water gas; consequently, at the best, we cannot count on more than four candles as due to the vapors in coal gas. It has been determined in England that washing the vapors out of the gas with heavy oils does not reduce the candle power over two candles. On page 123 the statement is found that the vapor tension of the benzole is reduced by contact with the tar films, tar surfaces, etc.; should this not say that the *amount* of vapor is reduced instead of the vapor tension? I would also like to ask at what temperature Mr. Slater thinks the gas should leave the water-cooled condenser, as compared with the average temperature of the atmosphere at any particular time of the year. In trying to determine this much-mooted question I have run across one or two facts which I will try to explain. Two questions confront us at the outset. What is the practical, critical temperature of the naphthaline, and what is the necessary resultant vapor tension of the absorbent vapors, that will take care of the naphthaline at the critical time? Mr. Slater explains how this second condition was fulfilled at the South works of Providence; but these conditions are very hard to obtain, and probably few of us ever do or ever will obtain them. For the past few years the Worcester (Mass.) Company has kept a series of charts showing the average temperature each day compared with the number of naphthaline complaints. It is found on examining these charts that in the fall, when the temperature hovers around 50°, the trouble comes, and for a week or ten days, while the temperature remains about 50°, naphthaline is the most prevalent; and it is possible each fall, by keeping track of the temperature, to tell within a few days when the trouble will commence and when it will end. To further check this point, and find the average temperature of the gas in the pipes at this time of the year, I calculated from the amount of drip liquor pumped from the pipes outside the holder, the fall of temperature of the gas after it left the holder, and from the known temperature of the gas, as it left the holder, in a saturated condition, I found the approximate average temperature of the gas, as it left the mains, to be 49°. This temperature would actually be found about midway between summer and winter, and at about the time we get the naphthaline. I was able to check this figure by some data once taken in Boston, where the average temperature of the earth at a

depth of three feet was found to be 48°. This all leads us to reason that the practical, critical temperature of the naphthaline carried by the gas in the mains is about 50°. The question now comes: How is the temperature of the gas at the outlet of the condensers to be regulated so that, when the gas comes to this critical point, as it necessarily must in this climate, the naphthaline will not drop out in crystals. In regulating the condensers we must remember that the gas must pass over the holder water and become saturated at a given temperature determined by that of the atmosphere. Mr. Slater states, as I understand him, that if we have a minimum amount of water vapor and a proper resultant vapor tension, that the naphthaline will take care of itself. But to do this, the naphthaline and the vapors must stand and fall together, which, as we all know, is a very difficult thing to make them do. It leaves the question, as I take it, somewhat in this way: Shall we cool the gas at the condensers, below the critical point, and thus have all our trouble at one point, or shall we condense to a safe margin above the critical point, and be free from trouble from mid-spring to mid-fall, have some trouble in the distributing system in the fall and spring, and then take care of it at the holder during the winter? The unpleasant part of the first scheme is taking care of it in the condensing apparatus. In the second plan, we might have trouble for a little while in the fall and spring, when the gas reaches the critical temperature in the distributing system, and possibly during the winter have some trouble with the inlet and outlet of the holder when the gas reaches the critical temperature at the holder; but this trouble at the holder can be greatly, if not entirely, obviated by having a large holder with large inlet and outlet pipes; or the trouble both at the holder and in the distributing system can be greatly reduced by either washing the gas with a heavy oil in a washer scrubber, and thereby remove the naphthaline, or by introducing some hydrocarbon vapor which will absorb the naphthaline at the proper time and place, or by using both these schemes.

Mr. J. J. Humphreys, Jr.—I should like to know if there is in use a centrifugal extractor removing tars and hot vapors from crude hot gas, but if there is not, undoubtedly the cream separator people could make a separator that would throw out any vapors, commencing at the heavy end and carrying it up to any point that we wish. Of course, it would entirely depend

on the peripheral speed of the separator. I don't think with Mr. Slater, that you can let naphthaline leave the works at all and *never* have any trouble from it. If it is not economical to make a gas without naphthaline, then when the ground reaches the proper temperature you can either remove it (and some of the other vapors) at the works by extreme condensation and friction, or else let it leave your works with the certainty that it will deposit wherever it has to endure low temperature and friction for a sufficient time.

Mr. A. B. Slater, Jr.—There is no question as to the high candle power of acetylene, but the amount of it in coal gas is relatively quite small, and it is quite soluble in water. The real value of an illuminant must be determined on a commercial basis, and it is to be noted that for coal gas enrichment benzol vapor is quite largely and successfully used, especially in Europe, while acetylene succeeds best when by itself. With practically the same volume and temperature the less the tension, of course the less the actual amount of the vapor. To determine the proper temperature of the gas on leaving the last condenser, examine the composition of the gas and conditions of distribution. As regards a critical temperature for the deposition of naphthaline, that was something I was very much unable to determine. I found that, instead of being able to establish any really fixed temperature or approximate temperature at which the bulk of the naphthaline should appear, it would vary with the conditions of distillation and condensation so that you could bring it down almost anywhere in the works. You could bring it down easier than you could stop it, of course. But it depends so largely on the conditions of distillation that perhaps that should be made an important point here, fully as important as the condensation; for instance, if we use very fine coal, moist, and consequently have to charge a little lighter than we would with a nice quality of coal, unless we are very careful we are apt to make a great deal more naphthaline under such conditions than we would if we had nice coal, so that we should charge our retort pretty well up and get the gas out of the way quickly and not crack up our lower hydrocarbons so as to get a mess of naphthaline and marsh gas there. The naphthaline standing or falling with the vapors, I would make to be a result rather than an initial condition. The whole moral of the thing is—

make as little naphthaline as possible, and send no more into your distribution than your vapors can handle.

Mr. J. J. Humphreys, Jr.—The amount of condensable vapors in the gas is 1.2 per cent. as usually given. Butterfield, I think, gives it so.

Mr. A. B. Slater, Jr.—Regarding the centrifugal tar extractor, I tried that myself as a matter of experiment, and know of three or four other instances in which it was tried, but it naturally would not be a commercial success. My trial of it was to note whether it would be possible to make a commercial success of it, and particularly to determine what the effect on the candle power would be. I found it affected the candle power very considerably, because as the tar was thrown to the outside and run around in the shield (I had simply a small blower), the heaviest vapors are also thrown out just in proportion to their specific gravity, so that if you undertake to do that thing at ordinary temperature, why your heaviest vapors are jammed hard up by centrifugal force against your tar there, where the tar can get right to work and absorb them as fast as temperature will allow. So the thing would have to be run very hot anyway, and I don't think it would ever be commercially successful, on account of the stratification of the vapors there, putting your heaviest vapors against the tar. If I skipped some points that were brought up, and if you will ask me the questions again, I will try to cover them.

Mr. McKay—As aqueous vapor and naphthaline are intimately associated in both coal and water gas, will Mr. Slater tell us if he has ever made any test of coal gas to determine whether the vapor it contained was that corresponding to saturation for a given temperature, and, if so, what is the highest temperature at which he has found coal gas to be saturated with aqueous vapor?

Mr. A. B. Slater, Jr.—The amount of aqueous vapor is almost always in my experience found to be slightly below saturation. That is, the precipitation of aqueous vapor I have found to exceed that required to maintain the vapor of saturation during decrease of temperature. I have not carried any experiments above 140° F., and up to that point there is quite an amount of aqueous vapor, well up towards saturation.

Mr. McKay—What percentage, Mr. Slater? Ninety per cent. of saturation?

Mr. A. B. Slater, Jr.—I should say quite ninety per cent.

Mr. McKay—If it would carry ninety per cent. at 140°, it would very quickly become saturated as the temperature fell?

Mr. A. B. Slater, Jr.—Yes.

Mr. McKay—That is, a few degrees lower would make it saturated?

Mr. A. B. Slater, Jr.—Yes; when the temperature has gone down to a point at which the amount of aqueous vapor in the gas has been concentrated to saturation, the further reduction of temperature will condense a proportionate amount of aqueous vapor, that which remains in the gas at any such lower temperature being theoretically at saturation for that temperature, provided conditions are such that temperature *only* is considered as affecting the vapor.

Mr. Africa—Mr. President, I should like to ask Mr. Slater if he has made any experiments relative to the effect of pressure on naphthaline. Suppose the gas at two inches pressure will carry a certain amount of naphthaline, what proportion of it will it carry at eight inches? Mr. Addicks raised the question that if the gas was saturated with naphthaline, that is carrying all it will, if the temperature is reduced will the naphthaline be thrown down? Now, if the gas in the storage holder is, say, eight inches pressure, it will carry a certain amount of naphthaline. We send it out to the mains, and the pressure reduces to, say, two inches. Will that reduction in pressure help the gas carry the naphthaline, and will it be enough to offset the reduction in temperature? I note that the plants which are distributing gas under what is known as high pressure report no deposits of naphthaline, in the services or mains. They evidently have enough reduction in pressure to offset any reduction of temperature they may have. The point is how much reduction in pressure must we have to offset a certain number of degrees loss in temperature?

Mr. A. B. Slater, Jr.—I think I get the idea. I have not made experiments on that point sufficiently to give a really good answer; but I should naturally expect that the reduction in pressure would favor the retention of the naphthaline in

suspension, or you might call it gaseous solution, if I may use the term; I should expect the naphthaline to be better carried as the pressure was reduced and the temperature maintained within reasonable limits, or if the relation of temperature and pressure were maintained so that the charged vapor tensions and boiling points retained their position *relative* to each other, the status of the naphthaline solution would not be changed. I should not care to say that I thought it would be so through very wide limits though.

Mr. McKay—With respect to this matter of pressure, and as having a bearing on Mr. Africa's remark does not Mr. Slater think it remarkable that, recalling the paper we heard yesterday, where the pressure is raised to thirty pounds, and the gas is chilled below zero, there is no occurrence of naphthaline mentioned in the writer's paper?

Mr. A. B. Slater, Jr.—It seems to me that it would not be anything very strange to see naphthaline deposited if much aqueous vapor were condensed, or even if much of the heavy hydrocarbon were condensed, but in the latter case the naphthaline would probably be in solution in the resulting liquids. Evidently the gas that has been compressed in that way was well made and well condensed gas. I should doubt very much that it contained much naphthaline.

The Secretary—According to my recollection the statement was made in the paper, that in the district supplied by high pressure, there was no trouble from naphthaline deposits, but in the district supplied with the same gas, under ordinary pressure, there were numerous cases of trouble from naphthaline or frost.

Mr. A. B. Slater, Jr.—I think the idea might have been brought up at that time as to what happened during the compression of that gas, what was the effect of the condensation there. If the same gas distributed under low pressure will give a deposit of naphthaline and will not at a higher pressure, what becomes of the naphthaline? How have they taken care of it, if not dropping it at the time of compression?

The President—I want to ask Mr. McKay whether he thinks that watery vapor has very much to do with the deposit of naphthaline. Our friend here on my left seems to think so. I take it from our friend Prichard that he does not believe in it.

Now, I want to hear from you; and, before you answer that, if I remember correctly, some twelve or fifteen years ago, it was Mr. Lucien Brémond who made very elaborate researches in regard to the question of naphthaline, and he thought it was due wholly to watery vapor, and was a great believer in drying the gas. That created a great deal of discussion in England, and for a long time there were many publications on the question of naphthaline. If I remember correctly, Mr. William Young and Dr. Eitner, by a great many tests, took the ground that aqueous vapor had nothing whatever to do with the deposition of naphthaline. I think that point should be brought out here a little more fully. I doubt if it has much to do with it. Nobody has made any mention in regard to taking out naphthaline by using oil in the standard scrubber. Now, that can be done and done effectually. You will say, "Well, it will take out your candle power." It will, if you allow the oil to keep dropping into the scrubber; but if, in the first place, you should put in a certain amount of naphtha, you would find there would be no loss in candle power whatever. However, you must be careful to see that there is no tar in that scrubber, for if there is, you will get into serious trouble. A very thick emulsion will be formed.

Mr. Addicks—I want to move a vote of thanks to the writer of the paper, and also incidentally to congratulate the Association that we now know all about naphthaline and how to take it out of our gas! (Laughter.) The motion was adopted.

Mr. A. B. Slater, Jr.—The formation of naphthaline, and subsequently anthracene from benzole, is done by increasing the heat; that is, you distil your benzole from the coal in the retort, and if you allow it to remain in contact with the hot coke or with the surface of the retort it will, by absorption of heat, crush together two benzole hexagons, the benzole rings as they are called, and you will get naphthaline and ethylene; and by continuing that process, that is unite three benzole rings, you form anthracene and more ethylene, and then you form pyrene and chrysene in a similar way. A large part of the ethylene liberated in this way is probably broken up by the heat into marsh gas (methane), with the deposition of the surplus carbon in the retort. I have actually found cases where I thought I had a small quantity of naphthaline, but on exami-

nation I found, instead of having all naphthaline, I had a little naphthaline with quite a lot of anthracene, chrysene and pyrene, although it looked like naphthaline, the cause being always found to be unusually high heats and slow motion of the gas. Reference has been made to the paper by M. Brémond, and if any of the members care to look that up, they will get track of it in the *Gas World*, of 1888, Vol. 8, p. 11; and in the *Journal of Gas Lighting*, the same year, Vol. 30, p. 491. They will also find a reference to it in *Newbigging's Handbook*.

The President—The Secretary suggests that I had better present this question:

> "Which system of tar scrubbing is more approved: (a), By means of perforated plates or baffles as in apparatus of the P. and A. type; or (b), by means of a succession of water seals, as in apparatus of which the Walker tar extractor is a type?"

That question has been touched upon somewhat; but do you want to elucidate that, Mr. Prichard?

Mr. Prichard—I won't elucidate, but I will make one remark as showing the advantage of the Walker tar extractor. The average reduction of the sulphuretted hydrogen for the year, due to the tar extractor, was twenty-eight per cent.; that due to the condenser was nine per cent; that due to the first box was fifty-five per cent; that due to the second box five per cent.; that due to the third box nine-tenths of one per cent.; and that due to the fourth box three-tenths of one per cent.

The Secretary—I would like to ask Mr. Prichard if the other apparatus would not have taken this sulphide out if the Walker had not.

Mr. Prichard—Answering that question, I have not that record here, but the ammonia in the standard scrubber is cool and the temperature is relatively low, and we find on experiment that there is only a very small amount of sulphuretted hydrogen taken out by the standard scrubber, notwithstanding there is a large amount passing in the gas, for it has not reached the boxes yet. You have lots of it to operate upon, nevertheless the standard scrubber removes a very small amount of sulphuretted hydrogen; my remembrance of it is in the vicinity of fifty grains.

Mr. A. B. Slater, Jr.—Referring to the sulphuretted hydrogen taken out by the ammonia, I think in order to get satisfactory reaction there it is necessary to have the temperature fairly low and an excess of ammonia, and, of course, as the ammonia is absorbed in the scrubber there is not such a proportion of the ammonia gas free, as there would be in the case of a washer using the strong ammoniacal liquor. But in using a washer with strong ammoniacal liquor there may be quite a difference to some concerns because in doing that you get such a large proportion of your ammonia as salts and less free ammonia, and sometimes that makes a difference in the contract for selling your residual.

The President introduced Mr. C. A. Learned, of Meriden, Conn., who read a paper on

Building a Holder Foundation on Quicksand.[1]

When in the course of events it becomes necessary for a gas company to provide extra storage capacity for its increasing business, it is seldom that it has a choice of sites beyond its own generating plant; and that choice is an all important matter. Adjoining the works is a piece of meadow land, 300 by 500 feet, recently acquired by the company, on which it was decided to erect a new holder.

Meriden lies in a valley between high hills. There are three peaks to the west of the city, one of which rises 1,000 feet high, and from which most of the central and southern part of Connecticut can be seen. This spot is the highest ground between Maine and Florida, within fifty miles of the coast.

In the valley, which is claimed by some to be the original bed of the Connecticut river, is a soil which does not materially differ from one end of the town to the other, and consists of a sandy loam, a little gravel and plenty of quicksand. Most of the buildings in this valley rest on the skin which is found at various depths below the surface.

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1. The illustration given on page 149 was subsequently submitted by Mr. Learned.

Holes dug in the meadow above referred to revealed the fact that we were in the center of the quicksand district. Careful borings were made over a section, 120 feet wide by 250 feet long, to determine the thickness of the gravel, if any, and its distance below the surface. To the west of this section, and twenty-five feet distant, runs a shallow brook, twenty to thirty feet wide—shallow except in freshet time.

About seventy-five tests were taken, and the results laid out and plotted into curves so that we might locate the most desirable place for the site. The top material was a sandy loam, evidently a silt deposited from the overflow of the brook, when in past years it was not so confined; the next a good gravel, but very thin; below that a quicksand of unknown depth.

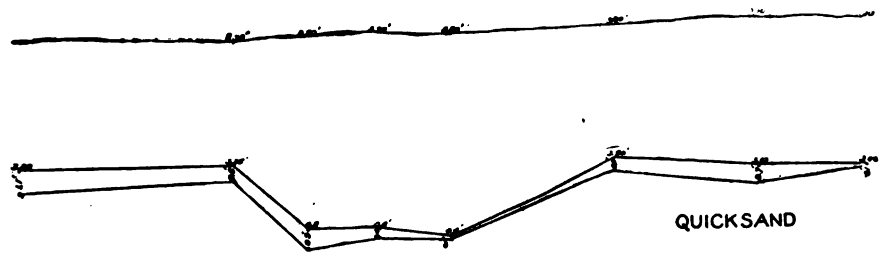
At a few points the gravel was found as near as two feet from the surface and two feet thick, while at the others it was 8.5 deep and only .4 thick, shading off to nothing. The average depth, however, taken from the boring stations, was 5.5 feet deep and 1.2 feet thick. A boring of fifty feet taken in the center of the site showed forty-two feet of quicksand and still more below.

On such materials it was decided to construct the foundation and erect a steel tank holder, to be 115 feet in diameter and 103 feet high, holding 700,000 feet of gas in three lifts. The weight of the holder to be 475 tons, and the weight of the water to be 8,625 tons, or a total of 9,100 tons.

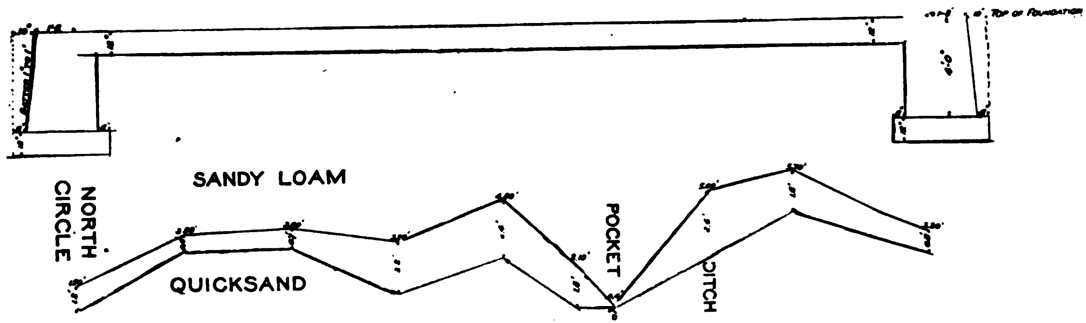
Borings were commenced as soon as the frost was out of the ground, and excavating was begun as soon as it was determined which was the best location.

As the work of excavating progressed and the gravel was exposed, there was found a clearly defined depression diagonally across the pit, as if at some time the brook had flowed through that way; for logs and trunks of trees were found together with a quantity of brush. Through this depression the gravel was very thin, and in three places the quicksand was entirely exposed—the first, a space ten by fifteen feet; the second, a space four by twelve feet; the third, a space three by fifteen feet. This was depressing indeed.

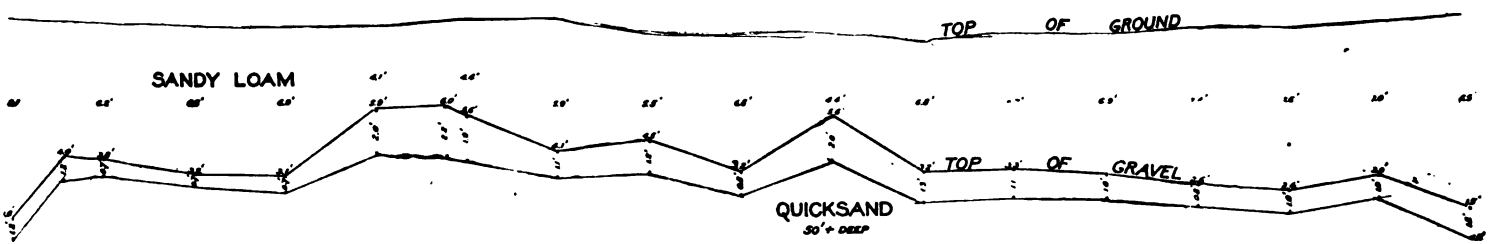
Hardly had the whole of the loam been removed when a rain came, followed by a heavy freshet, overflowing the meadow and deluging the pit. When the water had subsided energetic



PROFILE OFF CENTRE OF TANK WEST TO EAST SHOWING THICKNESS OF GRAVEL.



PROFILE OF CENTRE OF TANK.



PROFILE OF CIRCUMFERENCE.

means were taken to get it out as quickly as possible. It was pumped out in eight hours with a four-inch centrifugal pump and a seven and one-half-horse power motor, though the water was ten feet deep in some places.

The freshet convinced us more than ever that in erecting a holder it would be advisable to make the top of the foundation above high water mark, which in this case would mean a fill in some spots of twelve feet, with an average of eight feet, and the steel tank would be 2.5 feet above the level of the meadow.

At this point a difficult problem was confronted. As previously stated, Meriden topographically is on high hills and in a sandy valley; good gravel is a very scarce article. Four miles away, on the line of the railroad, is a large, poor gravel bank, and two miles in another direction is another small, good bank; but with all the teams that could be procured it was not possible to haul the material as fast as it was needed; and it was expensive—$1 per yard, delivered. It was evident that other and good material must be obtained in large quantities.

On the line of the railroad three miles away is a large trap-rock quarry, with which the New York, New Haven and Hartford Railroad is ballasted. Refuse, in the shape of iron-stone, soft rock and some dirt, is accumulated in large quantities. It was believed this stone would mix well with the material which was on hand and could be purchased, after it had been passed through the crusher to a one and one-half-inch size. This could be purchased at sixty cents per yard delivered on the works' siding, and in quantities up to 150 yards per day. About fifty yards of gravel and fifty yards of clean, sharp sand could also be procured each day, and as much ashes from the works as there were teams to put on it.

The question of piling was considered, and by some might seem the only wise plan under the circumstances, but after consulting our largest local builder, who had worked on this quicksand for thirty years, and had erected some very heavy factory buildings on it, it was thought best to put in a combination filling of the above named materials. As stated previously, the average gravel thickness was 1.2 feet. The color of the whole soil is that reddish brown stone color so common in Connecticut; Portland, ten miles away, being the center of the district where the best brown stone is quarried.

The quicksand is found hard packed and not easily dug, unless water is allowed to mix freely with it. Although the excavation was in places much below the level of the brook little water was encountered, and quite as much came from the land as from the brook side. By keeping the bare spots well drained the men could work upon the quicksand with a degree of ease without sinking in very deep; the less it was disturbed, however, the better off they were. Over these bare spots it was decided to lay plank close together lengthways of the holes, and upon these eight-inch by ten-inch timbers, eight inches apart, crossways of the holes. The filling between the timbers was of pieces of bricks and old retorts broken up fine, that being the best material at hand just then. One of the bare spots being narrow and long, the surface was covered with large flat stones, the smaller spaces being filled in with fine bricks and coarse ashes.

While working at this low level a pump was run night and day, also from these quicksand spots a 4-inch tile drain was laid to a central point to facilitate drainage and keep the mass from becoming spongy while the tamping was going on and each course of filling was laid.

Until the whole surface approached a level no roller could be used, but everything put in was thoroughly rammed and sprinkled. The layers were about three inches thick over the whole surface. When the valleys were evened up a 2-horse 4,000 pound roller was put on, and as the thickness became greater this roller was increased in weight to 6,500 pounds, requiring four horses. When the level of filling had been raised above the natural water level the pumping was dispensed with over night, allowing the foundation to be saturated, but pumped out again in the morning.

Near the centre of the foundation a loose brick well was built up into which the water ran as the foundation was successively wetted, and from which it was pumped to the brook. There were some high knolls of gravel not over three feet under the surface; it was thought at first that the five-foot concrete side wall foundation might rest on these, but further consideration convinced us that this was not advisable, as part of the foundation would rest on natural gravel while most of it would be on filled ground, so the whole level was raised one

foot to allow of the same kind of cushion underneath the whole structure, before the five-foot circle was started.

The layers spread each day over a diameter of 125 feet were about as follows: 125 yards of quarry refuse; 40 yards of good gravel; 50 yards of works ashes.

Towards the end of the work the ashes had become exhausted. Near by was a bank of 500 yards of sand, and from this was taken what was needed to make the top dressing under the concrete, spreading on the stone, washing it in and carefully rolling. Toward the end the roller worked night and day.

Near the edge where the wall of concrete was laid there was a space that could not be rolled, but had to be filled and tamped to a depth of four feet. In order to make sure that this portion was as solid as the centre, a round tapering bar five feet long was driven into the main foundation several times. Seventy blows on the average were required to drive it 4.5 feet, and the outside ring was tamped until it equalled the above test.

The amount of material removed approximated 2,900 yards. The work of excavating and filling ready to begin concreting took twenty-two days, and six days more were required to fill in around the great circle after the concrete wall was four feet high. This, however, did not delay the concreters in their work.

The filling was as per the following amounts:

Quarry stone or refuse,	1,780	yards
Gravel,	680	"
Sand,	310	"
Ashes,	1,100	"
Total,	3,870	"

Upon this foundation was laid 630 yards of Portland cement concrete in the following proportions: One of cement, two and one-half of sand, and five of stone. The size of stone was one and one-fourth inches and smaller. A great circle of concrete four feet wide and one foot thick was laid five feet below the finished top; on this circle was laid a ring three feet wide

at the bottom, tapering to two feet nine inches wide at the top, and three feet high; resting upon the ring was laid, over the whole diameter of 118 feet, a layer one foot thick, trued to perfect level and plastered smooth.

This work was accomplished in eighteen days, and in a most satisfactory manner, a local engineer taking the job at $4.90 per cubic yard laid.

As soon as the foundation was ready the iron men were on the ground and the holder was erected complete in a week less than the specified time of four months.

In order to prevent the action of the brook eating away the bank near the holder, a stone wall seven feet high was built to the level of the top of the holder foundation and 400 feet long, protecting also a new purifier building near the brook.

City water was used to fill the tank, as the brook water contained acids. It took three and one-half days to fill the tank, which holds a little over 2,000,000 gallons.

Before the water was put in careful levels were taken on eight points of the foundation. After filling, levels were again taken and there was not the slightest settlement.

Discussion.

The President—The paper is before you for discussion. Any questions to be asked?

Mr. Nettleton—We are under obligations to Mr. Learned for his paper, and he is to be congratulated on having built a large holder on very difficult foundations. Speaking for myself, with the description that he has given of the soil I should have hesitated, and I doubt if I should have had the courage to put up a holder on the foundations that he represents. I want to extend my hearty congratulations to him on the success of his work.

Mr. Allyn—I think Mr. Learned did not mention whether the cement was foreign or domestic.

Mr. Learned—It was Portland.

The President—What were the proportions?

Mr. Learned—One of cement, two and one-half of fine, sharp sand, and five of broken stone. The stone was very clean.

On motion of Mr. Prichard a vote of thanks was tendered to Mr. Learned for his paper.

The President—We will now have the last question in the box.

> "What are the advantages is passing the water gas through separate purifying apparatus in a works making both coal and water gas?"

I think the only gentleman who can answer that is Mr. Prichard, which he will do now.

Mr. Prichard—I never had any experience in line with passing it through separate purifiers only. All my work has been in connection with the other apparatus also. Personally I do not think it makes any difference whether you purify them together or separately.

The President—Any further remarks in regard to the question?

The Secretary—I would like to have brought out in connection with this the installation of shaving scrubbers for scrubbing water gas, which, I understand, is being done somewhat. We recently had some trouble with condensation passing on to the street and into consumers' meters, and it has shown at the burners. It looked to me very much like the condensation or the accumulation on the burners burning crude water gas in the laboratory, and I have been led to the conclusion that a part of this trouble might have been due to the fact that our water gas in the mixture was not properly scrubbed, as our condensing apparatus is overloaded.

The President introduced Mr. Charles W. Hinman, who read the following

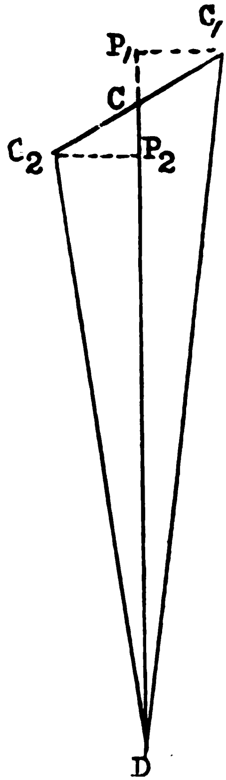
Notes on Candle Power Determinations.

In all English speaking countries the standard for light is the English spermaceti candle when burning at the rate of 120

grains per hour. This standard is not an ideal one by any means, as numerous precautions have to be observed to obtain accurate results, and sometimes when all the known precautions have been observed the amount of light given off by the burning candle or candles seems abnormal. The greater part of the variation in the burning of candles is due to the wick. A photometric observer after having used candles for some time is able to tell whether or not a candle is burning properly; and if he is at liberty to reject an occasional imperfect candle his results are more worthy of confidence than though he uses every candle that consumes the legal amount of material. The appearance of a candle flame when burning properly and when not so burning has been described many times, and I will not repeat the descriptions here. The necessity of proper ventilation of the photometer room is often overlooked. A small photometer room is hard to ventilate properly on account of the liability of drafts. If there are no openings in the room, and all the ventilation must be through the walls of the room, then the cubic capacity of the room should be at least 2,000 feet. Some of the older experimenters used photometers that necessitated moving the candles during the experiment. Although this procedure allowed a constant illumination of the comparison disk, and was so far advantageous, yet it was fatal to the normal burning of the candles and has been abandoned. The early practice was to use a single candle, and to place the lights under comparison 100 inches apart. This arrangement left the determination subject to the peculiarities of one candle, and also gave a comparatively feeble illumination to the disk, thus rendering careful screening necessary. Later practice has been in the direction of shorter bars, sixty-inch and eighty-inch, and two candles are generally used. This arrangement gives a better illuminated disk, and the light for comparison is the average of that given by two candles. While this arrangement answers fairly well for ordinary candle powers, it is not well adapted to testing lights of fifty-candle power, and cannot be used for lights of several hundred candle power. For testing these higher candle power lights it is a common practice to employ a secondary standard of ten or more candle power, which has to be first standardized by means of candles and then used as a standard. This is a rather cumbersome process, and is not always convenient.

Having had occasion to make some high candle power tests it occurred to me to use quite a number of candles instead of two.

Seven candles placed at the angles of a hexagon, and one in the center seemed the most available arrangement. To prevent the candles from being melted from the heat of adjacent candles, they were placed two and one-quarter inches from center to center This distance was found to be sufficient for the purpose. This makes the distance between the extreme candles four and one-half inches. The hexagon was not quite regular, but was distorted enough so that no candle was screened by another, and the appearance of the candles when viewed from the position of the disk was a row of flames three-fourths inch from center to center.



The question will immediately arise if a considerable error is not introduced by arranging the most of the candles so far from the center.

If a bar 100 inches in length is used, and lights of from sixteen to 110-candle power are to be tested, the error in question is quite insignificant.

In the Figure, let three candles, C_1, C and C_2, be in a straight line, C being midway between C_1 and C_2, D being the position of the disk. The illumination on the disk from the candles C_1, C and C_2 is inversely proportional to the square of C D, C_1 D and C_2 D. Drop perpendiculars from C_1 and C_2 on the line C D, and cutting it in P_1 and P_2, then:

$$\overline{C_1D}^2 = \overline{CD + CP_1}^2 + \overline{P_1C_1}^2 = \overline{CD}^2 + 2\overline{CD} + \overline{CP_1} + \overline{CP_1}^2 + \overline{C_1P_1}^2 \text{ and}$$

$$\overline{C_2D}^2 = \overline{CD - CP_2}^2 + \overline{C_2P_2}^2 = \overline{CD}^2 - 2\overline{CD} \times \overline{CP_2} + \overline{CP_2}^2 + \overline{C_2P_2}^2.$$

Adding these two equations, and remembering that $CP_1 = CP_2$ and $C_1P_1 = C_2P_2$, we have:

$$\overline{C_1D^2}+\overline{C_2D^2}=\overline{2CD^2}+\overline{CP_1{}^2}+\overline{C_1P_1{}^2}+\overline{CP_2{}^2}+\overline{C_2P_2{}^2};$$

but $\overline{CP_1{}^2}+\overline{C_1P_1{}^2}=\overline{CC_1{}^2}$,

and $\overline{CP_2{}^2}+\overline{C_2P_2{}^2}=\overline{CC_2{}^2}$,

hence $\overline{C_1D^2}+\overline{C_2D^2} = \overline{2CD^2}+\overline{CC_1{}^2}+\overline{CC_2{}^2}$.

That is, the sum of the squares of the distances of the three candles from the disk is equal to three times the square of the distance from the center candle to the disk, plus the sum of the squares of the distances of the two outer candles from the center one.

In the arrangement I have adopted there are: One candle at the center, four candles each two and one-fourth inches from the center, and two candles each 2.60 inches from the center.

$$\begin{array}{lr} 1\times 0^2 & = 0. \\ 4\times 2.25^2 & = 20.25 \\ 2\times 2.60^2 & = 13.50 \\ \hline & 7)33.75 \\ \hline & 4.82 \end{array}$$

That is; the average of the square of the distances of the candles from the center candle is 4.82.

Our sixteen-candle power light will require the disk to be placed at about forty inches from the candles. Our 110-candle power light will require the disk to be placed about twenty inches from the candles. The square of the geometrical average of these two distances is 800, and the square root of this number is 28.284. If our average square of the distance from all the candles is 800, the square of the distance from the center candle to the disk will be 4.82 less, or 795.18, the square root of which is 28.199. That is, the candles should be placed .085 inch nearer the disk than the scale would indicate. If this is done the maximum error due to the candles being not at one place will not exceed one-fifth of one per cent. for determinations ranging from fourteen-candle power to eighty-four-candle power. With a 112-candle power light the error would be one-third of

one per cent. The cost of the candles burned for one test would be about three or four cents.

As there seem to be no serious disadvantages in using seven candles it may be well to note the advantages. The greatest advantage is in eliminating to a great extent the fluctuations of individual candles. Of course, it is possible that a whole package of candles may not be satisfactory, and then it will be advisable to use candles from some other package. It is also an advantage to use a light as a standard that is large enough to allow the comparison disk to be used at a distance of from two to three feet from the standard light. Seven candles at a distance of two feet give a light equal to 1.75 candle at one foot distance. Seven candles at a distance of three feet give a light equal to .78 candle at one foot distance. Using a sixty-inch bar with two candles, if the candle power of the gas is sixteen the illumination on the disk will be equal to 1.17 candle.

The use of seven candles as a standard permits of the direct determination of the illuminating value of lights of several hundred candle power, if a bar of sufficient length is used. I have recently had occasion to make tests of rather high candle power lights, and have used with considerable satisfaction a bar of variable length. The seven candles with their balance are contained in a well ventilated box, two feet long, one and one-half feet wide, and two feet high. To this box is attached a support for the sight-box, and along the support is the scale. The closest reading to the candles that is allowed by the construction is two feet, and the sight-box has a travel of two and one-half feet. The light to be tested is contained in a box similar to the one containing the candles. Numerous screens to shut off outside light were provided. The lights can be placed only seven feet apart, and then lights of less than three-candle power can be tested. The lights may be placed the length of the room apart. When they are sixteen feet apart, a light of more than 300 candles may be tested. Of course, it would scarcely be possible to have a scale, giving direct readings of illuminating ratios, for every length of bar, and so a uniformly divided decimal scale having its zero point at the center candle was used. As the extreme readings are scarcely more than an inch apart, it is not necessary to square each reading but only

to square the average reading when making the calculations for candle power. A slide rule is very convenient for making these computations, as it gives results of sufficient accuracy in a third or a fourth of the time required by logarithms or arithmetic. I can strongly recommend this style of photometer to anyone desiring to test lights of either a few candle power or of several hundred candle power.

A simplification of the ordinary procedure and subsequent calculations in candle power determinations which I do not remember having seen in print I think worthy of being brought to your attention. The formula for photometric determinations with candles is the following:

$$\text{Average candle power observed} \times \frac{\text{number of grains of candle burned per hour}}{120} \times \frac{5}{\text{number of ft. of gas burned per hour}} = \text{corrected candle power.}$$

This formula condenses to—candle power observed

$$\times \frac{\text{grains of candle burned}}{24 \times \text{feet of gas burned}} = \text{corrected candle power,}$$ the candles and the gas being burned the same length of time, which may be an hour or a tenth of an hour.

This formula may be transposed to the following:

$$\frac{\dfrac{\text{Candle power observed}}{\text{Feet gas burned}}}{\dfrac{\text{Grains candle burned}}{24}} = \text{corrected candle power}$$

To use this method there is required, besides the ordinary photometric apparatus, a three-way cock that may be turned by the operator while observing the candle balance. One branch of the cock is connected to the gas supply, another one with a pipe leading direct to the gas burner, and the third connects with the meter.

The gas is passed through the meter and burned from the desired burner at the proper rate. The cock is then turned so that the meter is by-passed and the state of the meter is taken.

The candles are lighted, and when they are burning properly the balance is adjusted so that the candle's end is somewhat the heavier. At the instant the pointer of the balance crosses the zero mark the three-way cock is turned so that the gas passes through the meter. A weight is now added to the candle end of the balance and observations are made at the disk until the pointer of the balance again crosses zero. At that instant the three-way cock is turned so as to by-pass the meter. The state of the meter is again taken and the difference between the two states shows the amount of gas consumed. The weight placed on the balance shows the amount of candle burned during the test. The only calculation required is to divide the average candle power by the amount of gas burned, sometimes using a multiplier, the quotient being the candle power of the gas corrected to a rate of burning of five feet per hour for the gas and 120 grains per hour for the candle. Of course, the amount of gas used should be corrected for temperature and pressure. The formula is correct for any length of time, but six minutes is probably the most convenient period. In six minutes one candle should burn twelve grains. If twelve grains of candle are burned the formula becomes:

$$\frac{\dfrac{\text{Candle power observed}}{\text{Feet of gas burned}}}{\dfrac{12}{24}=\dfrac{1}{2}} = \frac{\text{Candle power observed}}{2 \times \text{feet of gas burned}} = \text{Corrected candle power.}$$

If twenty-four grains of candle are burned, or two candles are used, the formula becomes:

$$\frac{\dfrac{\text{Candle power observed}}{\text{Feet of gas burned}}}{\dfrac{24}{24}} = \frac{\text{Candle power observed}}{\text{Feet of gas burned}} = \text{Corrected candle power.}$$

If eighty-four grains of candle are burned, or seven candles are used, the formula becomes:

$$\frac{\dfrac{\text{Candle power observed}}{\text{Feet of gas burned}}}{\dfrac{84}{24}} = \frac{7 \times \text{candle power observed}}{2 \times \text{feet of gas burned}} = \text{Corrected candle power.}$$

It will be observed that there is no time observation required, but if required it may be taken by starting the stop watch at the instant of turning the cock at the beginning of the test and stopping the watch when the cock is turned at the end of the test.

The ordinary method of making the test requires four observations or readings to be taken to give the rate of burning of candle and gas; and if only one stop watch is used two of these observations consist in reading at the same instant two hands moving over two different dials. In the proposed method, at the beginning and also at the end of the test, a turn of the wrist is made when the eye observes that two marks coincide, and at leisure a reading is made of the position of the stationary hand on the meter dial.

The following example shows all the observations and calculations required with the method and apparatus described. The figures are from a test actually made:

	2.41	
Meter reading 0.650	2.37	
" " 0.100	2.38	Observed readings, in feet.
Gas burned = 0.550	2.36	
	2.37	
Temperature 71°	2.35	
	2.33	
Length of bar used 12.00 feet	2.37	
	2.32	
	2.34	
Average =	2.36 =	Distance of disk from candles.
	12.00 =	Length of bar,
	9.64 =	Distance of disk from gas flame.

$\left(\frac{9.64}{2.36}\right)^2 \times \frac{\times 1.03}{.560 \times 2} = 109 =$ candle power corrected to 5 feet per hour.

The two following examples are from actual tests, except that the readings on the bar are given in candle powers instead of distances:

					Bar Readings.
Meter reading,	4.586	(in	feet)		28.7
" "	3.950	"	"		28.7
	——				29.0
Gas burned,	0.636	"	"	at 72°	29.0
Tem. cor.,	.021				29.0
	——				27.5
Gas burned,	0.615	"	"	" 60°	27.5
					28.7
					29.0
Calculation:					29.0
					28.7
					27.8
					28.7
					29.0
					400.3

$$\frac{400.3}{.615 \times 4} = 162.7 = \text{candle power.}$$

Corrected to five feet per hour.

The time of burning was five minutes and thirty-six seconds, as taken by a stop watch ($=5.6$ minutes).

Then $\frac{.615}{5.6} \times 60 = 6.59$ was the number of feet per hour that was burned. Also $\frac{400.3}{14} \times 7 \times \frac{6}{5.6} = 214.4$ was the actual candle power observed.

It will be noticed that instead of multiplying the average reading by seven and dividing by two, fourteen readings have been taken and their sum divided by four. The distance between the lights was fifteen feet.

In the following test the distance between the lights was eight feet. These figures may be taken as illustrating the test of an ordinary gas when burned from an Argand burner.

	Bar Readings.
7.472 = Meter reading in cubic feet	2.45
7.000 = " " " " "	2.42
——	2.48
.472 = Gas used at 69^0 " "	2.45
.012 = Temperature correction.	2.42
——	2.37
.460 = Gas used at 60^0 in cubic feet.	2.42
	2.48
	2.52
	2.45
	2.37
$\frac{33.97}{4\times.460} = 18.4 =$ Candle power, corrected	2.40
	2.37
to 5 feet per hour.	2.37
	——
	33.97

Discussion.

The President—We will be pleased to hear from Mr. Jenkins, the Massachusetts State Inspector of Gas.

Mr. Jenkins—Mr. President, the latter part of Mr. Hinman's article, in regard to this novel method of taking candle power, appeals to me as being rather a neat way of doing it. An objection that appeared to me is this: Unless we use the stop watch occasionally, to take the time of the candles' burning, there may be an inaccuracy from the balance. In the new way, if the balance is inaccurate, of course, the determination would be thrown out. If the balance is working accurately, and the candles are burning within the ordinarily used limits of burning, it would seem to be a very neat way of making candle power determination. Possibly it would not be well suited for works' use, but I think it would be for office use. Where you make a number of readings of a meter with stop watches you are liable to make errors in your calculations. In regard to using the seven candles' standard for high candle power testing, it seemed to me that so long as the candle is the ultimate standard for even high candle power observations it would be well to use seven candles, or any other number of candles, directly in the measurement, as to use some secondary standard as, for example,

an Argand burner. I remember making some tests of electric arc lights. We first tested with one candle against an Argand burner with blue chimney—the colors of the lights were very different—and then with the blue chimney Argand standard against the electric light, and the colors were then again dissimilar.

On motion of Mr. Africa a vote of thanks was passed to Mr. Hinman for his paper.

The President introduced Mr. George F. Macmun, Jr., of Marlboro, Mass., who read the following paper on

Gas Engines.

Mr. President and Gentlemen: This paper relating to gas engines is for the purpose of narrating my experiences and observations, in which I hope may be found some ideas that will be useful to those who have occasion to come in contact with gas engines; also, for describing the difficulties I have encountered with engines of various types, and the methods for correcting same, and the outlook of the gas engine as a reliable, economic and satisfactory source of power in cities and suburbs that have and know the intrinsic value of this rapidly spreading and invincible factor, gas.

The gas engine received its success from Dr. N. A. Otto, who constructed and marketed the first engines to give satisfactory results. Others have since been placed upon the market that give high percentages of efficiency; still, there are others that have gained the prejudice of many engineers. These come from the persons who look for the lowest priced engines they can find, and taking for sufficient guarantee, without regarding or consulting experts to investigate the construction, the oily tongues of the many salesmen who claim their engine is the best. Good advice is to pay your money for the best engine there is according to expert testimony and the reputation of reliable manufacturers.

The principle of the four-cycle engine which is generally in use is understood by most gas engineers. It requires two revolutions of the crank shaft to complete the operation of one

impulse, or four cycles or strokes divided into the suction on the outward stroke, compression on the inward, ignition taking place just before the end of the stroke is completed, which gives a lead to the final explosion of the mixture just sufficient to bring the point of maximum pressure at the beginning of expansion stroke, then the expansive and exhaust strokes. Thus the same operation is continued in succession while the engine is under full load.

A modification of the four-cycle engine was produced by Mr. Dugald Clerk, in the '80s. This engine used a pump for forcing the mixture into the cylinder under pressure just at the end of the expansion stroke. This eliminated the suction and the exhaust cycles. Clerk's engine was the pioneer of what is now known as the two cycle, or engine which completes its operation for one impulse in one revolution.

Modern two-cycle engines are after the principle of the Day type. .Its crank shaft and piston end are incased, forming a chamber wherein the charge is mixed and forced into the cylinder at a sufficient pressure. On the inward stroke the piston draws in a charge of gas and air through a check valve in the side of the chamber; on the outward stroke the mixture in the crank chamber is compressed to a pressure of about four to six pounds to the square inch. As the piston uncovers the inlet port, which is a tube connecting the crank chamber with the cylinder, placed externally, the pressure drives a portion of the charge into the cylinder, which is compressed on the next stroke of the piston, ignition taking place at the best point to obtain the highest efficiency, about 5° below the center. The piston is then on its expansion stroke, when the products of combustion are expelled by the fresh charge forcing its way through the uncovered port.

Summary for each impulse: There are two operations, two in the cylinder, and the other two in the crank chamber, completing the work in one revolution. The difficulties that may occur to an engine, while it is in operation, are not always determined by a slight observation, and a set of rules cannot be accurately made to cover all engines, as the mechanism varies with the types. Principally the primary troubles with the gas engine are failure to start, loss of power, after engine is in use a year or more, explosions in the exhaust port, and

premature explosions. There are several other minor troubles of small importance which can be found easily.

Considering, first, the starting of an engine. This point, in some gas engines, is a subject for continual discussion, and is the searchlight of criticism. As previously stated, it derives its circulation from the users of inferior engines.

When an engine fails to start, the first point is to determine which portion of the mixture is in excess of the correct proportion. Closing or opening the gas valve, or choking the air on engines that have the gas valve opened by vacuum, allows a larger draught of gas to enter the cylinder.

Engines with the hot tube type of ignition fail to start occasionally by the accidental shifting of the air shutter causing an imperfect combustion of the gas which elevates the lowest point of incandescence on the tube, and consequently the distance of ignition is increased.

An engine in this condition operates with an unnecessary waste of gas, loss of power, and frequently a secondary firing in the exhaust pot or pipe. The temperature of the tube when below its standard, which is approximately 1,650°, for perfect operation of the engine, is the prime basis for the conditions given above, which are very easily corrected by the simple adjustment of the air shutter.

In the present era the best methods for ignition are either the make-and-break type of electrical device, or the jump-spark in connection with the Ruhmkorff coil. Almost any electrical device for exploding the gases is more positive than the hot tube, and inexpensive in comparison to renewals of tubes and cost of gas for heating, to cost of battery replenishments.

An incident worthy of mention which I experienced quite recently was the improper location of electrodes in a certain engine that proved to be the greatest bulk of annoyance that I ever encountered. This particular engine had its electrodes in the exhaust passage, which I think you will all agree is not the correct location for contact points in any engine. If the contact points are to be placed in any of the ports, I think a preference would be given to the inlet port, as the temperature of the points would be kept cool by the continual draught of gas and air.

Moisture was the seat of continual annoyance with this imperfectly designed engine. It is a known fact that moisture will collect in any vessel that is exposed to a raise or drop in temperature. The same conditions prevailed with this engine. In the morning when the engine was to be started moisture would collect from the rapid rise in temperature caused from the first explosion of the gases in the cylinder, which had adopted the temperature of the atmosphere over night. When the exhaust valve opened, this collection of moisture was carried by the electrodes, consequently causing a short circuit, in which all the current supplied by batteries was consumed, leaving the contact points without sufficient current to create the spark; and taking off the igniter plate was always in the programme for starting this engine. Another feature in the mechanism was the vacuum inlet valve, which I found took a large margin of gas per horse power.

Starting the gas engine is considered by some users of gas engines a task to which they are occasionally unequal. I have found operators who have motors that run at their will. These men start up hurriedly in the morning, throw a little oil at their machine and, positively speaking, the engine is left running until time for shutting down without any attendance. The very best engines built to-day will never work to advantage while the numerous men of this stamp operate them.

Now, when a man understands his motor and gives it the necessary attention, such as cleaning, oiling and examination of the points to remove any possible accumulation of carbon, he has mastered the common secret of successful operation.

Lost power is usually experienced after a period of use by some engineers. This is caused by a liberal supply of oil which carbonizes on the valve seat, and in consequence part of the compression is lost and the power developed is reduced in proportion to the leakage.

The quality of the lubricant for the cylinder, if not specially made, will create this lost power at an earlier period than with the use of high test mineral oils. Proper oil for use in cylinders is a thin lubricant that will not carbonize under high temperatures.

A method for obviating this carbonization is to place a tapping over the valves exposed to high temperature. Insert

an oil cup and fill with kerosene to be run in once a week while the engine is in operation, or an oil can to squirt a little kerosene on the valves and stems. This will cut every particle of carbon from the valve seat.

Explosions in the exhaust passages were fully covered under article on hot tubes' ignition. I might add that unexploded gases in the cylinder collect in the exhaust pot, and when of sufficient amount ignite. Premature explosions, commonly called back firing, occur from various causes. Gases rich in hydrocarbons, overheated cylinders, imperfect timing of ignition apparatus, or too high compression; finally a collection ot carbon in the cylinder becoming incandescent.

Heat is a great factor in the gas engine. Loss of heat is occasioned by the escape from the cylinder of the mixture at a high temperature. It is clearly essential to develop all the heat of which the original combustible gas is susceptible. This is obtained by complete combustion, which depends upon the method of mixing with air and igniting. Such are the requirements for good service in gas engines.

Gas engines have many points of resemblance to the steam engine. In one as in the other it is the expansion of a gaseous fluid which originates the work of the engine. Whatever the nature of the fluid, its elastic force is employed to move the piston. This fluid, then, is only an intermediate agent employed to convey heat, and giving up a portion during the process of transportation, the heat which disappears is converted into mechanical work and is the source of power in the motor. This co-relation of heat and motion is one of the most beautiful conceptions of modern science.

In the steam engines, heat is first employed in converting water into steam, and augmenting the heat of the steam. The vaporization is effected outside of the cylinder; that is to say, in the boiler and some time before the steam acts upon the piston.

It is quite otherwise with the gas motors; for in these the heat is developed within the cylinder and in the midst of the gaseous mass and only at the moment power is wanted. As there is no storing up of its heat or any transportation of it, these causes of losses are avoided. The advantages of such a mode of production and utilization of heat are apparent. In the steam

engine the time of firing up, of evaporating the water, and of raising the steam to a proper temperature is necessarily consumed. In the gas engine it is only required to admit the mixture by a single turn of the stopcock. Furthermore, the gas engine consumes fuel only while it is doing work. In this quality it possesses a great advantage over other heat engines and in those branches of industry which require any application of power. In all industries which require any amount of motive power the use of the gas engine is extending daily.

The fact that it is ready at a moment's notice, without the delay caused by lighting fires and getting up steam, or the expense of keeping up the pressure during intervals of work, and the small amount of attendance and its impossible danger from explosions, are some of the reasons that specially recommend it. On the other hand it has been long enough in use to enable practical men to decide on its durability.

To attain success in the introduction of engines, gas companies should employ a man who can talk engines with ease. The gas stove business has been pushed with remarkable success; why not exert the same amount of energy in the gas engine direction? It surely is as profitable, as the field for engines of all sizes is an expansive one.

Discussion.

Mr. Woodward—We have listened to a most valuable and interesting paper, and while it may not admit of much discussion here, it is one that can be taken home and studied, and a good deal of good, sound, practical information gathered therefrom. One of the bugaboos about a gas engine in my experience has been some difficulty in starting it. I have often been called up early in the morning to remedy this trouble with a gas engine. It is all treated very nicely in this paper. I think Mr. Macmun is entitled to a most hearty vote of thanks for his very valuable and interesting paper; and I so move.

The motion was seconded and adopted.

Report of Committee on Obituary Resolutions:

The following reports from the committees on obituary resolutions were read and received, and copies thereof were ordered sent to the respective families of the deceased:

GEORGE B. NEAL.

George B. Neal, one of the original members of this Association, died on the 7th of July, 1901, in the 78th year of his age. His connection with the gas industry dates from 1852, when he was elected Clerk and Treasurer of the Charlestown (Mass.) Gas Company, which office he held continuously up to the time of his death.

In 1875, he became prominently connected with the Lynn (Mass.) Gas Company, and in 1877 he was chosen Managing Director. He was also identified with the Somerville (Mass.) Electric Company. He was the first Secretary of the New England Association of Gas Engineers, and served it thirteen years. In 1884 he was elected a member of its Board of Directors, and served four years. This Association had its inception immediately after the funeral services of the lamented George Barnard Blake, who was at that time Mayor of the city of Worcester, and also Manager of the Worcester Gas Light Company. His death resulted from injuries received through an explosion in the purifying house at the gas works, in December, 1870. With the formation of this Association, Mr. Neal was actively identified, and its success has been largely due to his wise foresight and business ability. He became a member of the American Gas Light Association in May, 1874, and served as Second Vice-President four years, and also on various committees. He was made a member of the Guild of Gas Managers in December, 1881.

His was a marked personality. In all his connections with the several Associations and gas companies he was prominently identified with their deliberations and active in debate. His example, as a member of the various Associations and as a man, wherever he was known, was worthy to be emulated. His presence at the meetings of the Associations with which he was

connected will be sadly missed, and his consistent and upright life will continue in pleasant memory for a long time to come.

Signed, F. C. SHERMAN, HENRY B. LEACH, PATRICK COYLE, Committee.

DAVID W. CRAFTS.

Whereas: The Creator, in His Divine wisdom, has called, in the fullness of his years, our friend and comrade, David W. Crafts, to his eternal home, we hereby take this opportunity to express our appreciation of our loss, and also of him as a man and associate. He set an example that many a younger man might emulate to advantage. He was most enthusiastic in his love of his profession, and untiring in his devotion to his work. While one of the oldest members of this Association, and one of the oldest men in the gas business, he was always up-to-date in his ideas and methods.

He was the friend of all—the old and the young; and while constantly seeking information from others, he was always ready to impart to them of the store of knowledge and wisdom he had acquired during his long and varied experience. Genial and kindly hearted, his passing leaves a vacancy upon our rolls that will long remain with those who knew and loved him best.
Respectfully submitted,

H. F. COGGESHALL, W. H. SNOW, F. S. RICHARDSON, Committee.

FREDERIC C. BLOOD.

Mr. Frederic C. Blood, a member of this Associetion, died at his home, in Ware, Mass., on Feb. 24th, 1901, after a short illness.

Mr. Blood was for nearly twenty years connected with the Otis Company of Ware, and had under his especial charge the

gas department of that company's business, which he conducted with success.

Mr. Blood was a man of attractive personal qualities. His death is deeply mourned by his many friends and by his fellow members of this Association.

Signed, S. J. FOWLER, J. J. HUMPHREYS, JR. Z. M. JENKS, } Committee.

VOTES OF THANKS.

The President—Has anybody anything else to offer for the good of the Association?

Mr. Allyn—Mr. President, I would like to offer just one thing: That the thanks of the Association—I address this to Secretary—be tendered to our retiring President for the able, energetic, courteous, business-like manner in which he has performed his duties as presiding officer of this Thirty-second Session of the New England Association.

Mr. Addicks—Mr. Secretary, I would like to second that motion, and to thank the President for giving us a meeting so full and running over with good things, both at the meeting and at our banquet. There are those who have held the office that realize fully how much work it entails and how much thought is required by the President.

The motion as put by the Secretary was adopted unanimously by rising vote.

The meeting was then declared adjourned.

PROCEEDINGS

OF

THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,

Thirty-Third Annual Meeting, Feb 18 and 19, 1903.

Held at Young's Hotel, Boston, Mass.

First Day, Feb. 18.—Morning Session.

The Thirty-third annual meeting of the New England Association of Gas Engineers was called to order, the morning of February 18, by the President, Mr. William E. McKay, of Boston. The recorder's desk was occupied by the Secretary, Mr. N. W. Gifford, of East Boston.

On motion of Mr. Leach, the reading of the minutes of the last meeting was dispensed with.

The Secretary then read the

Report of the Board of Directors:

Mr. President and Gentlemen of the Association:

Your Directors would report that they have examined the following applications for active membership in the Association and recommend their election:

Bill, Benjamin P., Superintendent Capital City Gas Co., Montpelier, Vt.

Brockington, F. T., Superintendent Leominster Gas Light Co., Leominster, Mass.

Brown, J. S., Superintendent Clinton Gas Light Co., Clinton, Mass.

Cathels, Edmund, Engineer Providence Gas Co., Providence, R. I.

Corson, F. H., Superintendent Winnepesaukee Gas & Electric Co., Laconia, N. H.

Earle, Alfred G., Superintendent Bristol County Gas & Electric Co., Bristol, R. I.

Gifford, Charles Humphrey, Superintendent New Bedford Gas & Edison Light Co., New Bedford, Mass.

Leland, George B., Superintendent Norwich Gas & Electric Co., Norwich, Conn.

Lomax, Clarence, Chemist New England Gas & Coke Co., Everett, Mass.

Philbrick, J. E., Assistant Superintendent Brockton Gas Co., Brockton, Mass.

Polk, Roger W., Superintendent People's Gas Light Co., Rutland, Vt.

Tait, F. M., General Manager New London Gas & Electric Co., New London, Conn.

Wing, Dr. John F., Assistant Superintendent Boston Gas Light Co., Boston, Mass.

It was also voted that Mr. A. B. Slater be recommended for election to honorary membership. They would also recommend the acceptance of the following resignations: H. G. Thompson, Robert Todd and William H. Hill.

They recommend the transfer of F. W. Mace from associate to active membership, and also the election to associate membership of the following names:

Barnes, F. G. P., Assistant to Treasurer New Haven Gas Light Co., New Haven, Conn.

Campbell, W. F., Salesman, Perrin & Leaman, Boston, Mass.

Chisholm, Colin F., Assistant Superintendent Suburban Gas & Electric Co., Revere, Mass.

Dickel, William L., New England Agent H. Mueller Mfg. Co., Young's Hotel, Boston, Mass.

Dowst, Frank B., General Superintendent B. F. Sturtevant Co., Jamaica Plain, Boston, Mass.

Hall, Arthur S., Foreman East Boston Gas Co., East Boston, Mass.

Kerr, Joseph B., Foreman Distribution Department D. & H. Gas & Electric Co., Dedham, Mass.

Magee, John, Magee Furnace Co., Chelsea, Mass.

Meinshausen, Henry, Chicago, Ill.

Motley, George S., President and General Manager Lowell Gas Light Co., Lowell, Mass.

Russell, Duncan D., James Russell Boiler Works Co., South Boston, Mass.

Starkweather, Roderick M., Assistant Treasurer Northampton Gas Light Co., Northampton, Mass.

Tucker, C. A., Chief Clerk New Haven Gas Light Co., New Haven, Conn.

White, H. E., Superintendent Street Department New Haven Gas Light Co., New Haven, Conn.

According to the recommendation of last year, notice of the provisions of the constitution in regard to delinquent dues was sent to those members in arrears, and your board voted to send a second notice to fourteen members who are in arrears from two to four years, and if no response is received that their names be dropped from the list of membership.

Respectfully submitted,

N. W. GIFFORD, *Secretary.*

ELECTION OF NEW MEMBERS.

On motion of Mr. C. F. Prichard the Secretary was instructed to cast the ballot of the Association in favor of the election of the gentlemen named. Messrs. W.A. Learned and F.C. Sherman were appointed tellers. The Secretary subsequently reported that the ballot had been cast as directed, and the President formally announced the result.

The recommendation of the Board regarding the election of Mr. Slater to honorary membership was then put before the Association. A rising vote was taken and the nominee was declared unanimously elected, which action was formally announced by the President.

The consideration of the report of the Directors respecting the Library Fund was postponed, and Vice-President McGregor assumed the Chair, while President McKay read the following

INAUGURAL ADDRESS.

Fellow Members of the New England Association of Gas Engineers:

It is an honorable privilege to preside at a meeting of the oldest Gas Association—the only Association of Gas Engineers—in the United States. It is a pleasure to greet you with the knowledge that death has not lessened our membership since our last annual meeting.

The most important occurrence of the year, in New England, has been the strike of the miners of anthracite. Not only has the price of coal doubled and trebled, but in the last stages of the strike it was practically impossible to get anthracite at any price. Extending through six months, the effect of the strike made coal scarce in Boston, in July, 1902; in August the price had risen to $10 per ton; in September it rose to $12, then to $15; this last being nominal, for dealers would not accept orders. Cold weather turned people to seeking substitute fuel, and the advance of forty per cent. in the retail prices of wood and oil left alone gas to hold the dual honor of an uninterrupted supply and of an unchanged, uniform, low price. Although the duty was taken off coal it devolved upon gas. In November and December, 1902, and January, 1903, the output of gas increased at an unprecedented rate, the largest cities showing twenty and twenty-five per cent., while some of the smaller cities had an even larger percentage increase. The harmonious operation of combined coal and water gas plants lessened the inconvenience of the anthracite shortage, and made less difficult the response to the extraordinary demands on the gas supply. For some years the commercial side of our industry has been to the front, but the coal strike was such an insistent and effective solicitor for new business that the questions of manufacture and distribution again begin to push for precedence. The increase in the price of coals and oils, without a proportional advance in the selling price of gas or reduction in the candle power, still leaves us the hope for better results from the materials of manufacture.

It must always be a memorable credit to our industry that, in the very trying times of this winter, we have successfully met every demand for gas, maintaining the high standard of

quality without raising the rate to the consumer. It is generally expected that the recent education in the use of gas for cooking and heating will make permanent the exceptional consumption induced by the coal shortage. When we consider that this shortage was due to a decrease of only five per cent. in the annual output of coal, we must realize that the higher the civilization of a people the more interdependent is all industrial welfare, and a serious economic disturbance can follow a remarkably slight disarrangement of the normal relation between production and consumption. If it is coal one year it may be oil the next, and prudence suggests the multiple equipment of plant equal to all exigencies.

A banner year of construction must be near at hand, and as the engineer is, in the ultimate, the responsible factor, engineering knowledge and judgment will be in more constant requisition in every direction. Andrew Carnegie, in his rectorial address at St. Andrew's University, said: "Business methods have changed in the past twenty years. The old rule-of-thumb has given place to scientific precision. The technical schools furnish the young foremen and superintendents. Automatic machinery has developed a new class of workmen more intelligent than the old. The size of works has increased tenfold, and all processes are combined in one." This is just as true of gas as of steel and iron. As enduring success demands a business basis, the mercantile view of our gas undertakings must have an ever widening horizon. The companies that were small a few years ago are now large. The growth has been prodigious; but if we are to surpass our European contemporaries, output per capita promises that the future will realize an active demand exceeding even the general expectation. We seldom build too big, when the smaller cost per unit of capacity is considered, and not infrequently the new business exceeds anticipation. The experience of this winter enforces the wisdom of making the capacity of plant and the provision for new business as ample as means will permit. Construction companies can substantially promote the common adoption of rational standards, reducing some costs to gas companies without lessening builders' profits. The occasionally divergent views of those who build and of those who operate apparatus are appropriate reasons why the careful and scientific observations by superintendents should be more frequently formulated for the benefit of the profession.

The installation of inclined retorts is progressing close at home, and the combination of American coals and New England management forecasts a successful issue.

Purification has always been attentively studied, and still occupies an exceptional share of our care. I suppose that a reason for this exists in the legally defined duty of this part of the apparatus. In purification individual experience has not provided an acceptable guide to universal practice. The development of the very deep purifiers has met with much approval, and now has the additional recommendation of adoption in our territory. In this connection it may be noted that the reversal of flow of gas in purifiers (by which the serviceable activity of the material is renewed) may, with a dry center seal, be tested for two purifiers by turning the valve 45° instead of the usual 90°.

While English and Canadian gas coals have reappeared in some works, the experience of this winter has established some relative values for water gas making in petroleum coke, Welsh anthracite, retort coke, retort carbon, oven coke, and even semi-bituminous coal. Texas oil has been prominent in our print, and there has been some expectation of its introduction for large use in water gas. Mr. Rollin Norris, at the New Orleans meeting of the Western Gas Association, stated: "Analyses show that, for equal candle powers, the proportion of heavy hydrocarbons in gas from Beaumont oil is about seventy-five per cent. of what it is in gas made from Ohio or Pennsylvania oils. The result is that the gas made from Texas oil loses its candle power more readily under the influence of low temperature.

To judge from the reports of the State Board of Gas and Electric Light Commissioners, the residual market must be permanently satisfactory. For the companies making coal gas the returns from sales per ton of coal carbonized are larger for 1902 than for any year since 1899, increasing slightly each year. The year has done much to educate coke consumers, and in view of the shortage of fuel of all kinds (except gas) this winter, it is ancient history to read that, in January, 1879, the Boston gas works had 10,000 tons of coke stored for sale!

The pioneers of high pressure distribution receive well earned commendation, but the undetermined features of this system leave it still a field for serviceable investigation. The important

effects of compression upon candle power are not yet clearly stated, the limit of profitable compression has not been defined, and the flow of gas under high pressure has not yet been reported as the result of accurate and complete experiment.

The increasing use of the public streets for many kinds of distribution is a forcible reminder that first comers are first served to the best locations; and provision for large increase of business is more than ever apparent in the sizes of mains laid. Leaks of gas are not always from gas mains, and the electric currents are a disturbing factor in many unexpected ways. Gas companies whose mains are damaged by electrolysis are interested in the decision of Judge Brown, of the Court of Common Pleas, Montgomery County, O., in the case of the city of Dayton vs. the City Railway Company, April 5, 1902. He said:

> "The defendant has been and is operating its road in a negligent manner, causing continual damage to the water pipes of the plaintiff, for which the plaintiff has no adequate remedy at law, and cannot by any practical method prevent such damage. It is no excuse in law, and the facts would not justify the defense, that other electric lines in Dayton are contributing to this or doing like damage. It is, therefore, the duty of the Court to enjoin the defendant from so operating its railway, and to compel it, within a reasonable time, to introduce such improvements in the system, in order that the operation of the single trolley system will be in accordance with the present standard of the art of operating single trolley roads. The plaintiff shall co-operate to that end."

It seems, however, to be conceded that the only entirely satisfactory remedy for electrolysis is to provide for an independent conductor for the return of the current to the generator, completely insulated from the rails and from the ground. Electrolysis is only one of a number of causes that tend steadily to increase the cost of distribution of gas.

The extension of the use of gas for all purposes will result in a greater sensitiveness in the output as affected by the weather, by cold, or by rain and fog; the increase on cold, dark days will be extreme in amount, and will influence the needs in holder capacity.

Although more than half a million of the Welsbach mantles have been sold in New England in the past six months, and careful estimates of the use of the Welsbach state that ninety per cent. of the gas lights in Germany, and fifty per cent. in England, are so equipped, yet here the majority of gas consumers still use flat flame burners. The success of the arc or cluster lights has been phenomenal; this effective illumination has invaded mills and factories that had long been relinquished to the electric light. Much mutual benefit follows the use of their specialized or expert information by gas companies in supplying the needs of consumers; the maintenance and care of appliances, including incandescent mantles, after their installation will best sustain the merits of the appliances, and advertise the company's helpful interest in the consumer.

The Gas Commissioners report the number of stoves in use in Massachusetts as follows:

Year.	Number.
1896	42,592
1897	70,222
1898	78,558
1899	77,403
1900	88,201
1901	111,162
1902	126,535

No doubt this winter will show a percentage increase greater than ever. These figures show the effect of persistent educational work by the companies concerned. In Boston a number of large sized ranges have been installed in hotels and hospitals. The growing use of gas for heating lends fresh importance to the closely allied subject of ventilation; hitherto we have not paid to this feature the attention properly its due.

A signal feature of the year has been the use of gas engines of large sizes in central electric stations, on alternating current generators running in parallel. The merits and limitations of the steam engine are well known, but the possibilities of the gas engine tempt the imagination. Birmingham, England, is about the size of Boston, and Mr. Hunt states that the Birmingham gas undertaking supplies 19,000-horse power, using annually 800 million cubic feet of gas, and that this is entirely the growth of recent years.

In Massachusetts the gas supply has been taken over by the municipality of Holyoke, a city of 50,000 people. It may be of interest to note the rules adopted for the valuation of the property of the former Holyoke Gas Company.

1. The value of the real estate for what it was worth in the market as a part of the plant.

2. The cost of reproducing all parts of the buildings and machinery that could be duplicated, and the market value of such parts as could not be reproduced.

3. Depreciation from age, use, or other cause, of the existing plant to be deducted from the valuation of the reproduced plant as above determined.

I am glad that we have among our members the managers of at least two out of the four municipal gas plants in Massachusetts. The engineering interest of a gas plant lies in the management, not in the ownership.

In Germany, where our profession draws recruits in scores from the young graduates of the many technical schools, commercial chemistry and practical physics contribute in a marked degree to industrial progress and continual dividends. The laboratory is not a student's retreat, but a valuable business ally.

In its long and active life, this Association has done much in the development of gas engineering. The value of the papers presented does not measure the entire service of the Association to its members; the discussion of methods and facts, and the absorption of the ideas and experience of others have always been a stimulus not only to the participants, but to the silent as well.

In preparing a list of the printed papers that have been read before this Association, I was impressed anew with the great value of the material that is now filed only in the columns of the *American Gas Light Journal*. There was a freedom of debate in the early meetings that could profitably be copied now, and members were willing and eager to speak their minds. "Advice," says Fenimore Cooper's Leather Stocking, "is not a gift, but a debt that the old owe the young." And advice and knowledge were willingly received and freely imparted. Messrs. Lamson, Prichard and others have directed attention to the

increase of scientific knowledge in the members of the Association, but technical training will be handicapped if it ties its own tongue. The desire to state only facts, and to speak with exactness, is laudable, but to read some of the earlier debates it appears that members were then equally careful in statement, but much more ready to share in the discussion. I think the publication of our proceedings, both present and past, is an important work that should be promptly undertaken.

A familiarity with engineering literature is of very great value, and though our nearest interest is in a convenient reference to our own proceedings, it is of equal worth to be able to consult current information on many allied engineering subjects. A plan has been formulated to secure to members the opportunity to accomplish both these purposes, and to give the Association the use of a library as its headquarters. I commend this plan to your favorable consideration.

"No man," says Emerson, "Can do anything well who does not esteem his work of importance." Common sense recognizes the importance of the gas industry to the health, the comfort and the morals of the community. If "light is the great policeman," it is also true that the use of artificial light is an exponent of the education and civilization of a people. In relative importance to our profession, the engineering society follows close upon the engineering college. As experience alone can round out the judgment in dealing with technical matters, the publication of the experience and knowledge of one is a certain help to many; and the engineering society is the medium naturally chosen for the discussion of accomplished facts rather than hopeful theories. The better the preparation of the engineer the better the results in economy of construction and operation. The earning power is sometimes gauged by the learning power. Scientific training is, to the modern engineer, what the sights and rifling are to the modern gun; it "Condenses effort and accelerates the attainment of result." Our engineers also occupy executive positions in increasing numbers. A good administration is to be expected as the natural function of a logical mind, a mind trained in the fundamental principles of science, and backed by judgment and self confidence.

This Association deals with the economic application of elemental facts; but though we come here with our heads filled

with facts, we have need of and we receive much more than the mere recitation of experience, for the New England Association is strong in kindly sympathy and in fellowship; and it is a pleasant duty of your President to welcome the new members, and to give expression to your wish that the cordial and friendly relations which characterized the first meeting of the founders, in 1871, will always endure, and grow deeper and stronger with each succeeding session.

On motion the address was referred to a committee, consisting of Messrs. Chas. F. Prichard, H. A. Allyn and F. C. Sherman, for consideration and report.

First Day, Feb. 18 — Morning Session.

The President—We will now listen to the reports of the Secretary and Treasurer.

REPORTS OF THE SECRETARY AND TREASURER.

As Secretary, Mr. Gifford reported that at the last annual meeting there were added to the rolls the names of ten active and six associate members, which brought the membership up to the following, on date of February 17th: Honorary, 9; active, 146; associate, 60; total, 215.

TREASURER'S REPORT 1902.

Receipts.

Balance Feb. 17, 1902,	$156.94	
Dues 1903,	30.00	
1902,	177.00	
1901,	21.00	
1900,	3.00	
Admission fees,	70.00	
Sale of Badges,	10.00	
" " Proceedings,	14.00	
" " Dinner Tickets,	333.00	$814.94

Expenses.

For Hotel Bills,	$484.50	
Music,	12.00	
Telegrams, etc.,	2.23	
Postage,	5.35	
Sundries,	3.00	
Report of Meeting,	14.55	
Cuts,	13.29	
Salary,	200.00	
Balance Dec. 31, 1902,	80.02	$814.94

The President announced that the Treasurer's report had been duly audited and found correct, after which, on motion of Mr. H. B. Leach, the report was accepted, recorded and ordered placed on file.

The President then called upon the Secretary to read the following

SPECIAL REPORT FROM THE BOARD OF DIRECTORS.

To the Members of the New England Association of Gas Engigineers:

From an examination of the Treasurer's reports for the past four years it appears that the yearly surplus of receipts over expenditures will range between $100 and $150. The printing of the "Proceedings" for the years 1900 and 1901, in one volume, cost $515; the net cost will be reduced by the number of surplus copies sold. It is recommended that the "Proceedings" of the present and of the former meetings be printed in book form, and distributed to members and placed on sale, as rapidly as they can be prepared for publication. There can be used for this purpose, of the money available from the library fund, $150 to $200 per annum, and also $100 to $150 per annum from the balance in the treasury of the Association. This will provide for an expenditure of from $250 to $350 yearly on the work of publishing. As considerable time will be required for the preparation of the material, the publication can be carried along as rapidly as the money is available. In the case of some of the meetings, as many as five years can conveniently be compiled in one volume. If any members

desire to help the work, additional subscriptions to the library fund would accelerate the completion of the reprint of "Proceedings."

The term "library fund" has been employed to describe the money subscribed, though it was proposed to use most of the money for the republishing of the "Proceedings." The opportunity to secure for the Association a headquarters, and the use of an excellent engineering library in a central locality, in a fireproof building, under exceptionally favorable circumstances, made it seem timely to prepare the question for the consideration of the Association. In the designated annual charge ($100) is included the privilege of the use of the magazines and books of the Boston Society of Civil Engineers; it covers all expense in connection with the use, light and care of the reading room as a headquarters, and provides shelves for the books of the Association. Several members have already offered to furnish a number of volumes of *Gas Journals* and publications bearing upon our industry.

Of the 220 members of the New England Association, 140 represent ninety New England companies, selling 11,000,000,000 cubic feet of gas per annum. There are, in New England, about forty-five companies not represented by membership in this Association; these forty-five companies furnish less than three per cent. of the total gas supply. The New England Association is better able to make an effective use of a library and headquarters than any other Gas Association. Of our members, one-fourth live or do business within five miles of Boston, one-third within fifteen miles, one-half within forty miles, three-fourths within 150 miles. This makes it possible to get the member to the library, or to get the library book to the member, without excessive transportation charges. The scope and character of the library and reading room under consideration are shown in the annexed pamphlet and photograph, which are made a part of this report.

In response to the circular sent to members in December, 1902, the sum of $307 per annum, for a term of five years, has been subscribed and more is assured to the library fund. We recommend the acceptance of the subscriptions, and the use of the fund for the purposes named in the circular of 22d December, 1902, and herein again described. We further recommend:

1. That the Board of Directors be also the Library Committee.

2. That the Library Committee be empowered to make rules for the proper conduct of the library, and to expend from the library fund such sums as may be necessary to carry out these rules.

3. That the Secretary and Treasurer of the Association be also the librarian.

4. That the librarian have charge of the moneys received from the subscriptions to the "library fund."

5. That the librarian report annually to the Association, stating receipts and expenditures.

The circular referred to, dated December 22, 1902, is as follows:

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
EAST BOSTON, MASS., Dec., 22, 1902.

To the Members of the New England Association of Gas Engineers and the Gas Companies of New England:

There is offered to the New England Association, by the Boston Society of Civil Engineers, an opportunity to rent space in its library, where books of the New England Association of Gas Engineers may be kept, and at the same time give to our members the privilege of access to its very complete and admirably catalogued library, which has about 5,000 volumes, and there are about fifty engineering periodicals received. Also, our members could have the use of their rooms for purpose of making appointments, letter writing, etc., when in the city.

It is felt by the Directors that if such a place were provided for the safe and convenient keeping of books, our library would soon grow to respectable proportions.

In this connection the matter of publishing our "Proceedings" in book form comes to mind, and it will be noted that, to continue the work as it has been begun, will demand more funds than the present current dues will provide.

In order to provide means to make these desirable ends available, without increasing the annual dues to members, the

Directors, at the last meeting, appointed the President and Secretary a committee to solicit subscriptions to a library fund for a term of five years, the proceeds of which shall be devoted to the above named purposes.

It is thought $100 per year would provide for headquarters at the Library of the Boston Society of Civil Engineers, leaving $200 available toward publication of our "Proceedings," and for other additions to our proposed library.

If the plan meets with your approval will you kindly fill out, sign, and mail to the Secretary, 26 Central Square, East Boston, Mass., the inclosed blank, stating the amount which you or your company will give annually for a term of five years, or such lump sum as you will give for this purpose?

It is very desirable that these replies should be received before the next Directors' meeting, or by January 7th, 1903.

WILLIAM E. MCKAY, Pres. } Committee.
N. W. GIFFORD, Secy. }

The catalogue with prospectus of the Library of the Boston Society of Civil Engineers, together with view of the library room proper, is appended:

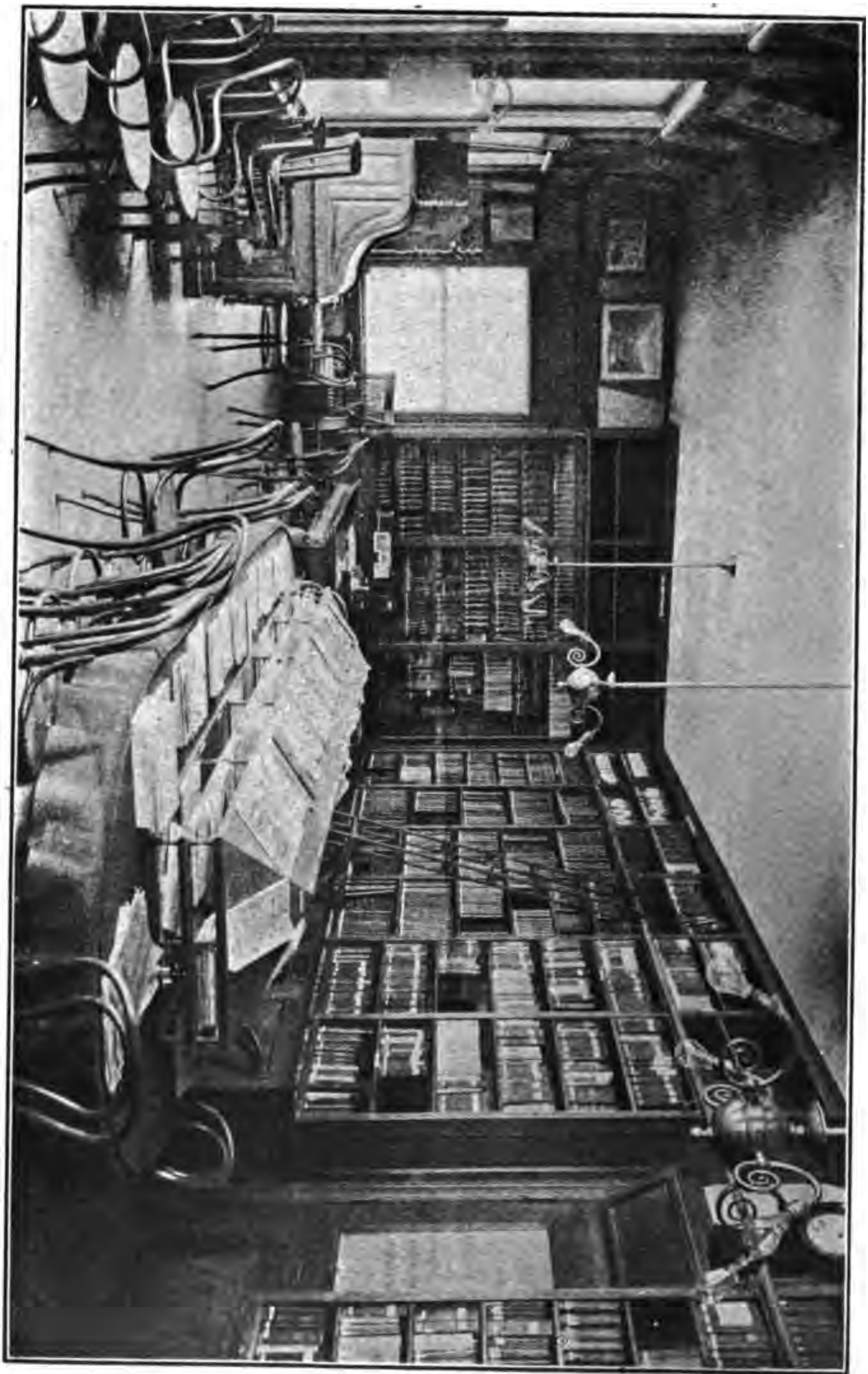
THE LIBRARY OF THE BOSTON SOCIETY OF CIVIL ENGINEERS.
715 TREMONT TEMPLE, BOSTON, MASS.

The library and reading room of the Society is open daily, except Sundays, from 9 A. M. to 5 P. M. Members desiring to use the rooms at other hours can purchase keys from the Secretary.

Among the bound volumes, or the periodicals regularly received, are the following:

"American Architect and Building News."
"American Engineer."
"American Gas Light Journal."
"American Institute of Electrical Engineers, Transactions."
"American Institute of Mining Engineers, Transactions."
"American Society of Civil Engineers, Proceedings."
"American Society of Irrigation Engineers, Quarterly."

"American Society of Mechanical Engineers, Proceedings."
"Association of Engineering Societies, Journal."
"Canadian Engineer."
"Canadian Society of Civil Engineers, Transactions."
"Cassier's Magazine."
"Electrical World and Engineer."
"Engineering (London)."
"Engineering Magazine."
"Engineering News."
"Engineering Record."
"Engineering and Mining Journal."
"Engineers' Club of Philadelphia, Proceedings."
"Engineering Association of the South, Proceedings."
"Engineers' Society of Western Pennsylvania, Proceedings."
"Franklin Institute, Journal of."
"Institution of Civil Engineers (London), Proceedings."
"Institution of Mechanical Engineers (London), Proceedings."
"Indian Engineer."
"Iron Age."
"Irrigation Age."
"Liverpool Engineering Society, Transactions."
"Master Car Builders' Association, Proceedings."
"Master Steam Fitter."
"Municipal Engineering."
"Municipal Journal and Engineer."
"New England Water Works Association, Journal of."
"Nova Scotian Institute of Science, Proceedings."
"Ponts et Chaussées, Annales des."
"Power."
"Railroad Gazette."
"School of Mines Quarterly."
"Scientific American Supplement."
"Société des Ingénieurs Civils, de France, Mémoires."



"Street Railway Bulletin."
"Street Railway Review."
"Technology Review."
"Technology Quarterly."
"University of Wisconsin, Bulletin."
"United States Naval Institute, Proceedings."
"United States Patent Office Gazette."
"Worcester Polytechnic Institute, Journal."
"Western Society of Civil Engineers, Journal."
"Zeitschrift des Vereines Deutscher Ingenicure."

There are upward of 5,000 books and pamphlets on the shelves; the card catalogue affords a serviceable guide to the publications. The room is quiet and pleasant, with comfortable chairs and tables. Each man can go to the shelves, look the books over and help himself without waiting for ceremony and attendants to bring him a selected book or two from distant and inaccessible shelves. This personal access to the book stacks accelerates the service.

The library has other possibilities than those of a professional workshop. The room is so attractive and so centrally located that it will always be found a convenient and pleasant place to spend an hour. It is well lighted and cheerful, by day and by night, and is a convenient place to meet friends, or for business engagements. The building is of fireproof construction, and has elevator service.

If a member from out of town desires a quiet place to write a few letters, or to look over some plans, he will find in the library a large table and a supply of stationery ready for use. If he should need a stenographer, he will find one in the adjoining room, who is prepared to serve the public. As a headquarters, the library is attractive and usable in many ways.

Discussion.

The President — What is your pleasure, gentlemen, with respect to this report?

Mr. Allyn—Mr. President, I think the Association is hardly ready to consider the matter at this stage. I move it be received and laid on the table for the present.

Mr. Woodward—I second the motion.

Mr. Prichard—Mr. President, I would like to inquire how long it would take to publish the complete "Proceedings" of the Association.

The President—The committee who looked the matter up thought that at the end of five years the "Proceedings" would be about caught up.

Mr. Prichard—I was wondering whether it would be possible to take a subscription among the members and get the "Proceedings" published at once, or before our next meeting. Would it not be possible for us to raise money enough to do that work at once, apart from the other?

The President—An item comes into the matter that needs to be considered—the amount of work that there is getting the volume out. I think Secretary Gifford will probably say that the work of getting out 1900 and 1901 was considerable. We want to keep up with what we are doing now, and also publish the "Proceedings" of the past meetings. Any further discussion?

Mr. Allyn—My object in making the motion was that I considered, as this matter was new to probably seven-eighths of the persons present, they would like to have an opportunity to talk it over among themselves and see whether this was a desirable movement for us to adopt. I certainly did not intend to cut it off entirely, but thought that it might be better to leave it until a later stage of the proceedings. It is well known that a great many of our companies are located at distances apart, and that the opportunity to discuss matters does not exist. It seems to me that at this early stage of our meeting, when we generally go on with the regular work of our Association, it is rather unreasonable to expect that we are prepared to take this thing up and discuss it as we should before deciding. It seems to me one of the most important schemes that ever has been devised for the Association, and requires careful consideration.

Mr. J. J. Humphreys, Jr.—Mr. President, I would like to offer an amendment to Mr. Allyn's motion, that this matter be made the first business of the afternoon session. (Seconded.)

The President—The vote will be upon the amendment. Is there any discussion? The amendment is, that this matter,

if it is laid on the table in the subsequent vote, become the first business of the afternoon session to-day. (Adopted.)

The President—The vote now comes upon the original motion. (The motion to lay the report on the table, as amended, was adopted.)

COMMITTEE ON NOMINATION OF OFFICERS.

The President—It is customary to appoint a committee to nominate officers for the ensuing year. What action will you take in this respect?

On motion of Mr. McGregor, the President was directed to appoint a Committee on Nomination of Officers for the ensuing year; and the President named Messrs. Charles H. Nettleton, S. J. Fowler and W. A. Learned as such committee.

READING THE PAPERS.

The President introduced Mr. S. E. Baker, of Fall River, Mass., who read the following paper on

METHODS OF BILL COLLECTION.

When a prospective customer makes application for gas to be supplied to his premises, he signs an application in which, briefly stated, he agrees to pay his bills; on the lower left hand corner of the application his occupation is given; this is obtained that we may be enabled to identify a man by his occupation in case a like name appears on our books.

No women's names are taken if there is a man at the head of the household, experience having taught us that sometimes a woman applies for and obtains a meter, while we have on our ledger an uncollected bill against her husband.

Canvassers, complaint men, and all connected with the company thoroughly understand this rule; and all acceptable applications bearing a woman's signature state that she is a widow, or unmarried, in order that the setting of the meter be not delayed.

We seldom require a deposit. Small stores, a traveling show, or a person whose credit is known to be very poor, are the exceptions to the usual custom. The total amount of

deposits on our books January 1st, 1903, amounted to $1,308, an average of about ten cents per consumer.

The meter set and removal card, besides the usual information, has two lines which read: "Moved to," "Moved from;" when a party orders a meter removed without ordering another one set he is asked by the order clerk, in a polite way, as to where he is moving, and this address is entered on the set card. This information enables the collector to locate the person in case any bills have been left unpaid; if the consumer is merely changing his residence and orders a meter at the new address, the old address is entered on the set card on the line "Moved from," so that if our records show that he has received shutoff notices at intervals, or if we have any reason to be doubtful of his willingness or ability to pay we are able to turn to his account and see if it is paid to date or past due.

In our office one man, in addition to other work, has the same relative duties that the credit man of a large commercial house would have. Necessarily he has no ratings, issued by a commercial agency, to guide his judgment, which must be based on his knowledge of the local conditions. The ability and willingness of the people to pay vary greatly in a city in which eight-six per cent. of the population is foreign born, or of foreign parentage, as is the case in Fall River. Secondly, as a guide, he has a record book, to which he turns to see if any information is contained in it which would affect the applicant's credit. This book is arranged like a vowel index for ease in quickly locating a name. When a shut-off notice is sent to a party the name is entered in this book with the date of the notice, the ledger number and folio. If the person is sent frequent shut-off notices a cross is put against the name; if monthly notices are the rule, the name is starred; thus the person has established a record of his credit, which will be a guide—if he wishes to purchase some gas appliances on time.

When a remove order comes before the credit man without a corresponding set order, "collect" is marked on the margin of the card, and a bill with the last reading is attached to the card. The name of the party and the address are then entered in pencil in the record book. If the party pays, the name is erased; if not, an entry in ink is made, giving name and address, and "Owes gas" is written after it. Usually from ten days to two months the name again appears before the credit man on

the set card and the payment of the old bill is made a prerequisite to setting the meter; thus bills for fractions of a month, small in themselves but considerable in the aggregate, are saved for the Company.

After the card is stamped with the name of the credit man it is given to the ledger clerk who has the district in charge, who enters on it the size of the meter required, reads carefully the name and address, and is encouraged to offer any advice that his experience may suggest. There is a friendly rivalry between the ledger clerks to keep their ledgers paid up to date, and to lose as small a percentage as possible of the accounts under their charge. To aid them in this, each collector reports directly to the ledger clerk in charge of his district, by whom he is questioned as to the advisability of sending this or that man a shut-off notice, the reason such a bill is not paid, and such other questions as would naturally occur to one interested in his work; and last, but not least, the collector is kept stirred to a continual state of activity. Stoves in our Company are sold on the monthly payment plan. When the stove is set the bill is rendered promptly and a printed slip is inclosed which reads: "Inclosed find bill for gas stove; the collector will call tomorrow" (here the date is written) "for the first payment." As a great many of our customers are employed in the mills, both husband and wife, we find this notice a great help, the money being usually left with a neighbor in anticipation of the collector's call. If a stove is returned to us, and the cause of the return has any bearing on the credit of the customer, an entry is made in the credit book giving name, date of return of stove, and the words "Stove returned."

Next season during the warm weather, if the party orders a stove, as he very likely will, we have information to guide us in passing upon his order. If an order comes in to disconnect a stove, and no request to set it elsewhere accompanies the remove order, the sales' ledger is consulted to ascertain if the stove is paid for in full, and if not, we act promptly, collecting the balance due or removing the stove.

On looking over our credit record I find entries—a few of which are as follows:

> Always in hard luck.
> Credit "N. G."

Slow pay.
Render bills promptly, as he always disputes.
Keeps returning goods.
Only fair pay.
Drinking man.
Usually hard up.
Have terms of sale well understood.

These entries enable the credit man to pass upon orders which otherwise would be filled without question—and probably at a loss. All sales of Welsbach supplies are made cash as far as possible, but where the collection is not made on delivery of the goods the bill is rendered promptly and is stamped

Terms Cash.

> This is made CASH: Not on account of any question as to your credit, but because it is impossible for us to open so many small accounts.

It has been our experience that if a Welsbach supply bill was allowed to run thirty days the collection of it was frequently accompanied with friction. The receipt of the goods sometimes being disputed, or if the mantle has become broken, the customer feeling that he ought not to pay for it. If a bill for supplies remains unpaid at the end of thirty days a statement, stamped as follows, is mailed:

Past Due!!!

> This account has, no doubt, escaped your notice. Will you please favor us with a remittance by return mail, and oblige?

If this brings no results the bill is then given to the collector.

When a meter is removed and the collector has reported that he is unable to collect the bill, a series of four notices attached to a statement of the account are mailed at intervals of a week each.

These notices are from "The Sayers Claim File," registered, and are as follows:

Please oblige by an early settlement of this account.

No doubt this account, which is long past due, has escaped your notice. Kindly oblige by an early settlement.

Your attention has been called to this account several times. We now desire to close same without further delay.

Several demands have been made for payment of this account and, unless it receives attention before... it will be placed in the hands of an attorney with instructions to collect with costs.

Final Application.

These notices prove a very efficient aid in collecting doubtful accounts. In theory every gas company reads all of its meters at regular intervals; in practice there are a few each month remaining unread. A memorandum of these meters is gone over carefully, and from the lists are selected such ones that it is bad policy in the judgment of the credit man to allow to remain unread. These are given to the shop foreman, who details a man to get the readings, and the man keeps at it until they are obtained. A file of the city directories is kept, a directory a year or so old frequently proving a man who disputes an old account to be guilty of misrepresentation in denying some previous place of residence. An over zealous man, by clinging too closely to his written record and not allowing his judgment fair play, would be apt, in a company where shut-off notices are frequently sent, to be a brake on the wheel of the new business department. While a carefulness in passing upon an order is to be expected, it is understood that the records of the Company must show sufficient reasons for requiring a deposit or other security. If the records show a man to be in debt the credit man should contrast the debt with the man's character and misfortunes. Some people of integrity, industry and good habits appear on our credit record, owing to a series of events which they could not control.

We welcome these people when they again apply for a meter, and adopt a series of easy payments on the old account. When a man, whose credit was poor, pays his old bill, and again

becomes a customer it is a mistake to be thrown off one's guard merely because he meets his bills with promptness.

A memorandum should be entered against his name in the ledger and his account continuously watched, so that history may not repeat itself. In closing, I will say that a credit record, to be of value, must always be kept up to date, and, in order to keep the loss on accounts receivable down to a fair average, no system can equal the results obtained by a diligent industrious collector, while an indifferent one will lose for his company many dollars.

Discussion.

The President—Gentlemen, you have heard a capital paper that gives a first rate working schedule. Certainly a great many members must want to add to the ideas that Mr. Baker sets forth.

Mr. Sherman—I would like to ask Mr. Baker to what extent, if any, his Company has adopted prepayment meters.

Mr. Baker—We have a few, about 275 in use; not very many in proportion to our whole number of meters.

The President—Mr. Jenks, have you not a different practice, although in the same neighborhood?

Mr. Jenks—I cannot say we have quite as complete a system as that. We have about the same class of population as that in Fall River. We have a deposit system that we carry out rather religiously. This paper of Mr. Baker's, however, has set me thinking, and I believe it will result in the revising of our system to some extent.

The President—I have heard a number of gentlemen say that since this paper has been published they have begun to use a good many of the ideas that have been advanced. Mr. Barnes, cannot you add to the number?

Mr. Barnes—The system which the paper outlines is very much like the one we are using in Cambridge at the present time, but we are more stringent on the matter of deposits than they are in Fall River. We require from entire strangers a deposit, or else a satisfactory guarantee from the owner of the property, or from some consumer whom we have known for a long time, unless a man should come to us with a satisfactory

recommendation. We don't find it easy to ascertain the man's standing, where we have 16,000 consumers, and people are coming in every day for new meters. It is not always easy to look them up and give them satisfactory service, and give them the meter as soon as they want to begin to use it, so we find it better to adopt the system of deposits and guarantees or strong recommendation. The method of collecting is very much the same there as it is in Fall River. I should like to ask the gentleman from Fall River if he can give us in an approximate way the results of this system; tell us what percentage of his bills rendered are uncollected?

The President—Perhaps Mr. Baker will answer that.

Mr. Baker—In 1901 we charged off of our total sales .48 of one per cent. That was the loss. In 1902 we reduced that to .39 of one per cent. That is what we charged off, and we charged it off quite religiously. In 1901, of that .48 of one per cent. we collected $82.24. Roughly speaking, we charged off, in 1901, to make it a little clearer, probably about $1,000, and in 1902 about $800. In 1901 we collected $82.24, and in 1902 we collected $208.69, with hopes of more to come. The other day I collected a bill two years old.

The President—You have heard how the seaport town accomplishes its good work. Will Mr. Woodward tell us how the mountains get along?

Mr. Woodward—We have listened to a most interesting paper, and one we would all like to have on file, but the thought occurred to me that what is applicable in Mr. Baker's case to a large company may not be so applicable to a small one. His system is good, and most systems are good. Method is what we want in our business. What he carries out through a printed record we largely carry out through the ability of the cashier, who has those points in her or his head. The cashier would be expected to know all the customers in a small company, and not only to know them by name but to know a little about their business, and of their ability to pay. The value of a good cashier or office man lies in just that knowledge, and that is one of the chief, if not the most important, positions that we have in an office. It has always been our experience that it was very valuable have a lady in an office. "An over zealous credit man, by clinging too closely to his written record and

not allowing his judgment fair play, would be apt, in a company where shutoff notices are frequently sent, to be a brake on the wheel of the new business department." That is a point that needs thought. Don't we put brakes on our new business department? We are often called "robbers" and "grasping monopolies," and we become a bit hardened to it. By insisting on payments and ramming shutoff notices down our customers' throats do we not open ourselves to some just criticism? The consumers often complain about their bills, but you should bear in mind that they have to pay for something that they don't see. They get the result from the gas, but they don't see the article itself. It is something that they neither taste nor see nor handle. They generally have little confidence in the meter, and often think the gas company is imposing on them. A long standing prejudice exists against gas companies, dating way back to the time when they could tell them they could take it or leave it, as they saw fit. Times are different now and we are trying to overcome these prejudices. There is a difference indeed between the dead beat and the unfortunate and temporarily embarrassed. Another point. The canvasser should not be asked to do collecting. The prime requisites of a canvasser are affability and power to make friends and to make sales. The collector is expected to bring the money in. He may possibly make some enemies. It never seemed to me that the two positions, those of canvasser and collector, should be embodied in the same person. It is by such little notices as, "We will call to-morrow for our money," that we may make ourselves perhaps a little unpopular. Let customers run over a bit on their agreed terms of payment. If they are not dead beats you will not lose anything by it. No company here loses more than three per cent. as the aggregate of all its uncollectable bills, and most of them not one per cent. Is this one per cent. worth such tremendous effort to collect, at the expense of giving your company a bad name or of being called grasping? In the sale of ranges we take a lease-contract, and it is a constant surprise to us to see how well those contracts, without any dunning whatever, are lived up to. In the collecting of gas bills most companies give a discount for prompt payment, and this is right and fair. The discount collects the bill. It is a good point in favor of a manager that he collects his bills closely, but he ought to do it with just as little friction as

possible. The price at which the company sells its product makes little difference with the number of complaints. The "kicks" come in just as often and just as hard on gas at seventy-five cents a 1,000 as they do at $3. I wish only to emphasize, in closing, that we guard against too rigorous attention to collections and thus put a brake on the new business department, and also cause our companies to become more unpopular with the people.

The President—In connection with this paper we might as well consider two of the questions, which are as follows:

> "In the use of prepayment meters, what methods are adopted for comparing the returns of the money boxes with the actual registration of the meter?"

Also:

> "How can the gas consumer be induced to read his own meter? If he would do this, would it not reduce the complaints of 'big bills!'"

I should like to have "Big Bill" McGregor tell us about that.

Mr. McGregor—We have a card system on the prepayment. The collector takes the cards out. He puts down exactly what the reading of the meter is, and also places in another column the amount of money he takes out. At the office the showing on the card is copied on a book. Of course, the cash is over the amount registered by the meter. I don't know that any other way can be taken to get it. It is sometimes unsatisfactory not to know exactly where you stand on the matter; but we have had no losses, demonstrating that the collectors we have are honest and that the meter is carefully registering all gas that goes through.

The President—With respect to the reading of the meter, has the education of consumers been generally undertaken? Mr. Nettleton, will you tell us the practice in New Haven?

Mr. Nettleton—So far as trying to educate consumers in reading meters is concerned, we are doing very little unless a person shows an interest. It seemed to me it was almost impossible to get the average consumer to take sufficient interest

in the matter to learn how, or if he knows how to read the meter he will rarely take the trouble to do so. In the matter of prepayment meters, however, we are following, perhaps, a different line from Mr. McGregor, and possibly it may be new to many of the members. I think the scheme was gotten up in Buffalo. A meter index book is made with loose leaves, one leaf for each consumer. Each leaf is printed in squares, with the months of the year printed, one month to each square. On the month, when the collection is made, the statement of the meter and the amount of money are entered. When the collector comes in at night he adds up, or it is added for him on an adding machine, the amount of money that he should have; he balances his cash and turns it over to the cashier. The statement books are turned into the book-keeping department, where the statement is entered on the ledger, and if there is an over or a short it is noted. If it is either way to any amount, a difference of, say, a dollar, the meter is taken out. When the man goes out the next month with the statement book he has absolutely nothing to guide him, unless he shall have made a memorandum on a private book of his own. He simply goes to that meter as an absolutely fresh meter and sets down the statement. While I am on my feet, Mr. President, I would like to call attention to a matter that was brought up here some years ago by Mr. Woodward, in regard to collecting past due bills by means of the prepayment meter and charging a higher price. At that time I think it was objected to by many members of this Association. I am now trying it in New Haven in quite a large way. The meters that are used for this purpose are painted blue, so that the collection meters are known to the men simply by the color alone. A person owes us a large bill, or a bill of any amount. He is unable to pay it. He wants to use gas. He would consider it an arbitrary act if we said he could not have gas. He is honest, but he cannot pay. We suggest to him that he use the blue prepayment, which is fixed to pay for gas at the rate of $2 per 1,000, $1 of which pays for the gas and $1 applies to his old account. If he assents to it he then signs a statement, stating the facts, that he owes us so much money and he wishes to pay it in this way. It has worked admirably. We have had out for several months about 130 of those meters, and two months ago they had collected for us on old accounts over $1,100. The "blue" meter has

been in use now for about fifteen months, and not a hitch has been found in it, so far as I know. I believe in that system of collecting. They are small payments; very small indeed; a quarter at a time on the old bill; but unless the meter is robbed the company gets it.

The President—Will any other member contribute his experience?

Mr. Coffin—Mr. President, we have adopted a system of prepayment meters. When our man goes to read the meter he takes it on the nearest even number (as we sell 200 feet for a quarter), and he then takes out of the box money enough to cover that reading, so that an overplus is always in the meter. Then the book and the money returned tally. Speaking of this collection, we found last year very much to our surprise that our collections were over 100 per cent. We had collected enough in lost discounts to pay the charged off bills and .7 of one per cent. over.

Mr. Crafts—I would like to ask Mr. Nettleton whether the blue meter was put in with the full knowledge of the people as to what it was for.

Mr. Nettleton—Yes; they sign a request asking the company to set the meter, in order to pay a bill which they owe the company of —— dollars. The request states that the meter is adjusted to use gas at the rate of $2 per 1,000, and $1 of this shall apply on the old bill. It is done with the full knowledge of the people. Otherwise there would be trouble, of course.

Mr. Crafts—In connection with bill collection, I think the difficulty with most companies is the collection of the small accounts; that is, what we call the material accounts. In our experience a good many small items for mantles, chimneys and tubing were difficult to get in. We would send in the bill at the end of the month, and there would be a good deal of friction over it. To help that we make a charge slip in duplicate, which is made practically in the form of a bill. One of them is left with the consumer—it is left personally with him if possible. We find that in perhaps fifty per cent. of the cases the people then and there pay that small bill, and we have no charge to make of it. In that way we have materially reduced the number of accounts of small items.

Mr. Fowler—Will Mr. Nettleton have any objection to printing that form of application for blue meters?

Mr. Nettleton—Not at all.

Mr. Fowler—I would suggest, then, that it be printed with this discussion. It will undoubtedly be interesting to many of the members.

REPRINT OF THE NEW HAVEN BLUE METER FORM.

New Haven, Conn.............................190

TO THE NEW HAVEN GAS LIGHT CO.:

Gentlemen—I am indebted to you for gas supplied in the sum of.................................. $\frac{}{100}$ Dollars ($),.................................. which I desire to pay, and for the purpose of doing so, I hereby authorize you to place for me at No.................................. a prepayment gas meter regulated to supply gas at the rate of 125 feet for each twenty-five cent piece, or $2.00 per 1,000 feet, with the understanding that one-half of the amount so paid by me shall apply on my indebtedness to the Gas Light Company above stated; and that as soon as said indebtedness is extinguished, then the meter shall be removed, and another meter shall be set, and thereafter I shall be charged the regular price for gas.

Approved:

.... Signed..

Is it residence or business place? ....

How long at place applying for?..

Where before?..

How long there? ....

Where before that? ....

....

How does name appear in directory? ....

Business or occupation? ....

Business address? ....

Remarks? ....

Mr. Woodward—I would ask Mr. Coffin his idea of leaving any money in the box. I should think you would rather have that surplus brought to the office. Most companies would rather get those collections in as soon as possible as a matter of safety, and often companies collect more than once a month in order not to leave money in the boxes any longer than they can help.

Mr. Coffin—Our folks don't put in large amounts. It is very rare that we leave more than one or two quarters there. It really struck me as though it was easier to take care of it the other way, to have one balance the other, than to be always carrying forward more money than the account called for. We have had but one box robbed, and we notified the parties that we should hold them responsible for it and moved the meter.

The President—Has there been any extensive use of dummies instead of coin in any of the cities represented?

Mr. Cooper—Mr. Barnes spoke about each company requiring a deposit. I would like to ask him, if the fact of having a prepayment meter to furnish a consumer did not bridge over the trouble of having to ask for a deposit in cash.

Mr. Barnes—Mr. President, I did not intend my remarks in regard to deposit to apply to prepayment meters. We don't require any deposit on prepayment meters. We require an obligation that, in case the box is robbed, the consumer shall be responsible for the contents of the box. They sign an application agreeing to be responsible for the contents of box until the contents have been removed or the meter removed by the company. I have a very vivid recollection, Mr. President, that last year our friend from New Haven endeavored to throw every possible protection around his employees in the matter of honesty, and he had a good many very excellent safeguards in that respect. I would like to ask him if he has any safeguard now to prevent a collector going about among these prepayment meters and reporting a less amount of cash than he actually takes out; whether that might not go on under his system for one or even two years, and the collector in that way be able to pocket quite a large amount?

Mr. Nettleton—I think, Mr. President, I did not make myself very clear, otherwise Mr. Barnes would have seen that the system does cover that very point. The statements of the

meters, not only the money but the reading, are handed in. Those are compared by the ledger clerk with the previous statements and with the money. When there is an over or a shortage amounting to $1, the meter is taken out, and we try to find out what the trouble is. Now, by changing the routes of the collectors occasionally, once in three to six months, all liability of losing in that way is done away with, if there is any risk at all.

Mr. Barnes—I think I understand the gentleman's system perfectly; but I would like to ask him what would prevent a collector going out today, for instance, and finding, as we find sometimes in our boxes, anywhere from $8 to $10, taking $10 out of the box, putting down the state of the meter 5,000 feet less than it actually is, and putting the other $5 in his pocket?

Mr. Nettleton—Then he must keep a private memorandum of the matter, because when he goes round the next time if he sets down the real state it will immediately show a shortage.

Mr. Barnes—That he could do, could he not, under your system?

Mr. Nettleton—He could do it; but what would happen when we changed the route?

Mr. Barnes—Then he would be detected. Do I understand that you make it a rule to change your routes periodically?

Mr. Nettleton—We make it a rule to change the routes, but not at any specific time.

Mr. Barnes—So that that man never knows which route he is going out on?

Mr. Nettleton—He assumes that he is going out on the old route until a change is made. He follows the same route for—well, two, four, six months. For a short time the company can lose money.

Mr. Barnes—How often do you collect the prepayment meters?

Mr. Nettleton—Generally once a month, but where there is a large amount, or where they are exposed to danger, once in two weeks, and I think there are a few once a week, but they are very few.

Mr. Barnes—We have only a small number of prepayment meters out; I think at the present time something between 350

and 400. Up to the present time our system has been this: We send a collector to the prepayment meter twice a month, and in connection with the regular reading of the other meters those prepayment meters are read by the regular meter reader, who has nothing to do with the collecting. The meter card is tied in for a prepayment meter just the same as it would be for a regular meter, and that becomes a part of the regular meter reader's route. He goes to the house and puts down on his card the reading on that day of prepayment meter. That is compared in the office with the return sent in by the collector. I don't know whether that is a sufficient safeguard to warrant the extra trouble in a place where they would have as large a number of prepayment meters out as I understand they have in New Haven; but it seems to me an excellent safeguard for a moderate number of prepayment meters, such as we have in Cambridge.

Mr. C. A. Learned—Mr. Barnes and Mr. Nettleton have struck a very important point. In Meriden we have something like 1,200 prepay meters. Two-fifths of all of our meters are prepay, and about one-fifth of all the gas that we make passes through them. A few days since the auditors, in looking over our books found that there had passed through prepay meters something over twelve million feet, and for that we had obtained something over $16,000. The question arose at that time what check we had upon the meter indexers. They were told that we had six very reliable young men who took the prepay indexes monthly at the same time that they took the regular meters. One of the directors a short time since happened to come into the office when a number of hundred dollars in quarters were lying upon the table. He asked the manager what check he had upon the prepay system, how he knew that the index was taken correctly and that the collector did not put some of the money in his pocket and give an incorrect index. It was so important that it was then decided that one of our young men should pass around once in six months and read all of our prepay indexes, taking no money, so that that reading could be compared with the index taken by the regular meter taker and we could see if it was correct. The change of routes was thought unadvisable, because that would run into a great deal more expense than having a young man go around once in six months to check up the indexes.

The Secretary—I would like to inquire if any, or how many, are charging more for their gas in the prepayment meters—that is, leaving out the question of blue meters—than their regular rates.

The President—Will those who do so please raise their hands? [One hand was raised.] Those who charge a larger price for gas bought through a prepayment meter will please raise their hands. [Two members raised their hands.]

Mr. Coffin—I would say that the difference comes in figuring out the amount of gas to sell for a quarter. We sell our gas regularly for $1.20, which is twelve cents per 100. We will sell 200 feet for a quarter, which is at the rate of five cents per 1,000 more than the regular price, but it is the nearest I could get it.

Mr. Woodward—That is the only qualification I wish to make. Our rate is $1.35 net. We ought to give our consumers 186 feet for a quarter, but we set our meters at 180 feet, so that they do not get quite as much gas as they are entitled to; but that cannot be obviated.

The Secretary—Then I understand from this expression that the general practice is to get nothing for the increased capital cost of setting the prepayment meter, except in freedom from worry, from bad debts and deposits. I would also like to inquire about the setting of prepayment meters in the same kind of places that you would set ordinary meters. The question of the protection of the prepayment meter has always been enlarged upon. The question has come up in my mind whether the risk is not smaller than has sometimes appeared, whether if the consumer were held responsible for the safety of the meter, for the gas as registered by the meter and the money box, the liability to loss by theft would not be practically so small that we could neglect it.

The President—I think an answer can be given to Mr. Gifford's question. Those who have suffered a permanent loss by theft from prepayment meters I will ask to raise their hands.

Mr. Woodward—What do you mean by a permanent loss?

The President—A loss not made good by the person for whom the meter was installed. [Four hands were raised.]

The President—Will those who have not endured a permanent loss raise their hands? [Several hands were raised.]

The President—About an even matter. Is there any other gentleman who wishes to speak on this subject?

Mr. Scranton—In Derby we have about 2,250 prepay meters, which is over fifty per cent. of the meters we have out. We are setting those meters in the same places in which we originally set our common meters. Most of our meters are set in the cellar, near the riser. We don't make any distinction if a customer applies for a meter; if it is in the hallway we put it in and take our chances. We have averaged, I should say, about one a month, in the last six or eight months, that has been broken into. The amount of money taken from those will not average over $1.50 a meter. The majority of them are very small. One very funny thing happened. We had two meters, one right beside the other; one was broken into and one was not. The one that was broken into contained twenty-five cents; the other contained $6.75. I presume likely the man who made the theft found there was so little in the one he broke into that he would not take the trouble to open the other one.

The President—Mr. Baker, will you please reply?

Mr. Baker—I would like to say, in reply to my friend in the front here, who said that in a small company all the knowledge they have is the knowledge in the head of the cashier, that that used to be the way in our company. Of course, it is now so large that the cashier would not have the time for it; but even in the small company wouldn't it leave him where he began if his cashier should pass away or get transferred? Then as to our notice that the collector will call to-morrow for the $3. I rather inferred that he thought it would cause friction. Well, it does not. We talk in the gas business of educating the people; we always say we educate them to do this or that. I believe I heard it remarked here this morning that we should train them to read their meters. If you let the first payment on your gas stove slide over a few days, the average foreign consumer, to use a slang phrase, thinks you are easy, and when your next dollar payment comes along it is likely to go another week or two, until finally you are going to have $4 or $5 in arrears. Then you have to say, "Give up, or we will take the

stove." Even if sending out these notices and insisting on getting the first payment, which with us is $3, does cause friction at the beginning of the campaign, I think that a little friction for a few months, or for whatever time is necessary, is worth while when you consider the ease in getting in your money that you will enjoy in all the years after you have educated your people to it.

In regard to the prepayments, I will say that we used to make change in the till, as the gentleman on my left says, but we found that took time. It adds to the cost of reading prepayment meters considerably, and as compared with the cost of reading straight meters it runs it up a great deal. We take all the money. One man is in charge of the consumers' ledger that has prepayments in it. We keep the prepayments in a separate small ledger, ruled just the same as our other ledgers. He keeps a running footing of all the feet used, and a running memorandum of all the money. Suppose it does fall twenty-five or fifty cents below this month; it probably has gone up seventy-five cents a few month back and we are even, so we say nothing. If there is any great discrepancy, why then that particular meter is taken out, tested and examined, and a thorough examination given to find whether the fault is in the meter reader or in the collector, or whether it is in the mechanism of the meter. Of course, the footing of the prepayment ledger always shows an overplus, and we take care of that on our bookkeeping by putting it in our liabilities, making an entry debiting prepayment sales with the footing of the meters at $1 per 1,000, which is our net rate, and crediting it with the actual money received. It shows an overplus of $15 to $25 a month. In that way we always know what we owe on prepayment meters. We also change our meter readers every month. No meter reader is allowed to read the same book two months consecutively. We start the reader out at the beginning of each month with a different book, and he gets another book when he brings the first in. We don't know what book he will take out the next time, it all depends on what book he brings in; but he does not get the same book in two consecutive months.

Mr. Barnes—In answer to the question by the Secretary, I would say that in Cambridge our rule in regard to the setting of prepayment meters is that we will not set a meter where

anyone outside of the consumer or his family has access to it. If it is in a building where there are two or more meters in the same cellar, we decline to set a prepayment meter. The only exceptions we ever made in that case were when people have been willing to make a deposit of $5 or $10 for the security of the box for the convenience of having a prepayment meter. They have made that proposition themselves, and we have in one or two instances accepted it. Otherwise than that, the rule is that the meter shall be under the exclusive control of the consumer, and shall only be accessible to him or to some member of his family.

The Secretary—In reply to Mr. Barnes I would say that in my limited experience with prepayment meters I have found this works admirably when I wanted to head off the demand for a prepayment meter, but when a case came along where I wanted to put in a prepayment meter and the consumer was not willing to come up with a deposit or pay for a box I have the feeling that that rule rather ties my hands.

Mr. Prichard—Coming from the city of agitators, and hearing the talk about educating the consumer to read his meter, makes me think that it is about time for us to agitate the question whether a meter cannot be devised that can be read without the aid of the differential calculus. That is stretching it a little, but it is a matter of fact that the ordinary gas meter is an extremely difficult thing to read, for the ordinary person. I don't believe there are many cities in which you do not have from ten to fifty mistakes a month made in taking your meters, and for everyone of those mistakes you have a man that goes about the city and tells what a swindle the gas company is. The most prolific source of complaint that we have in this whole business is the imperfect taking of the meters. Let a person have a bill this month of $1 and a bill next month of $3, and you may carefully explain to him that the first month's bill should have been $1.50 and the next month's bill should have been $1.50, but you cannot make him believe it if you talk till you are black in the face. Those mistakes are constantly being made. The only way in which we can educate the people to read the meters, and the only way that we can obviate the trouble of which I speak, is to have a meter that can be read by an ordinary person and that can be read quickly by any meter taker that we send out. I wish that we

could start right here an agitation to see if that thing cannot in some way be brought about. [Applause.]

Mr. A. J. Campbell—In reply to the gentleman who last spoke, and in this connection, I would like to ask if anybody has had any experience with meter clocks, in which the position of the hands is marked instead of the reader putting the statement down in figures. Wouldn't that tend to obviate the difficulty?

Mr. Prichard—I had some experience in that way in taking electric meters, and it works very nicely. You can send anyone out to take the meter. I think it helps reduce the number of errors made.

Mr. Nute—I would like to say that the meter that Mr. Prichard is looking for is, I understand, about to be put on the market. It is a direct reading meter, which shows the figures. The figures appear above the regular dial of the meter. If the reading is 961, say, the figures appear there. I saw one of these dials two or three months ago, perhaps, and I understood it was very soon to be put on the market. It causes an addition of only two wheels, I believe, in the mechanism, and seemed to be a very simple and very nice arrangement. I understand it will make a very small addition also to the cost of the meter. I am very glad we are going to get it.

Mr. Mansfield—I used to find that teaching the people to read the meters was rather an easy way sometimes of getting rid of someone who thought there was a mistake in his bill, by showing him that if he knew how to read the meter he could easily see there was no mistake. A few minutes attention in that respect would possibly make them think that they were the mistaken party, after all. Then, perhaps, if you followed it up some time afterwards they would say, "Well, I went down to look at it, and I came to the conclusion that I would give it up." Still, perhaps the trouble that caused the excessively large bill may have been removed and the next one may have been all right.

Mr. Barnes—Touching the subject that Mr. Prichard has introduced, I will say that two or three years ago I had a talk with a prominent meter maker in Boston in regard to this very idea of a dial on the meter which would show the exact registration, something after the plan of a dial showing the number

of revolutions of a crank of a steam engine. He told me that that had been tried, and experiments had been made. I think he told me that meters had been made in that way and found not to work well. I wonder if any gentleman in the Association has ever seen or heard of anything of that kind, or has had any experience with it?

Mr. Barnum—In Danbury, Conn., where they have several rather queer ways of making gas, they have a meter that has been used for a number of years, the dial of which reads directly in dollars and cents. When they first started to make gas there they made the price $10 per 1,000; to be sure they got it high enough. They still use those meters, but they have so many discounts to make that if a man wants to know how much his bill is he has to go through a calculation of four or five discounts to get the amount. The meter itself works all right, but it does not do what it was originally designed for, on account of the price of gas being changed. It performs one act however, it effectually covers up the actual price of gas per 1,000.

Mr. Allyn—I am simply going to throw out a hint that I thought our old friend Sherman must remember distinctly a meter that was made, I should say, thirty-five or forty years ago, in which the figures could be read distinctly. I remember that there were round openings in the dial through which the numerals appeared.

Mr. Sherman—I remember seeing such a meter, but have had no experience with it. I think it was made by W. W. Goodwin & Company, of Philadelphia. It never came into general use.

Mr. Hintze—Among the many relics left by the late John Andrew, to whose position I succeeded in 1892, was a three-light meter with a dial the same as a steam engine counter, with numerals from left to right. I don't know what became of the meter or whether it was ever in use.

Mr. C. A. Learned—I suppose most of the members must be familiar with the reading on electric meters. Any of you that run an electric light plant have seen them. They work with very good results. You know, too, that the electric meter is a very intricate little piece of machinery. If the cyclometer reading will work well with electricity, I should think, with a

pressure of anywhere from one and one-half to four inches on a gas meter, it should work equally well.

The Secretary—I would not like to appear before this Association as opposing any suggestion put out by the member from Lynn, but I would like to ask one more question. I won't even ask the question, but I will just mention it. How many of you gentleman who think you know how to read a gas meter ever read your own meters? (Laughter.) That being the case, suppose you had a meter which would read in letters of fire, how many of you could get your present consumers to read it? To return to the question about the reading of consumers' meters, the thought occurred to me that possibly some of our bright advertisers who are so generous with their advertising matter, which they throw in with the stoves and other appliances that we buy of them, might be able to get up some sort of a novelty memorandum calendar, perhaps, which we could put out at no great cost to ourselves when we sell a gas stove, and have the selling agent in his most persuasive way present this to the lady operator of the cook stove and say that if she would hang this up at the side of her cook stove, and every week or few days note on it the reading of her meter, the chances would be that the bills would be satisfactory to the head of the house, and she could continue to use the gas stove instead of going back to the hot coal range.

Mr. Allyn—I desire to reply to our Secretary's question whether any of the gentlemen here ever read their own meters. I have a distinct recollection of reading mine once. That was on the occasion of my receiving a gas bill the month succeeding the installing of a gas range in my house. The bill was for $44. Thinking there must be some mistake, I read the meter on that occasion.

The President—I interpreted the applause that greeted the reading of Mr. Baker's paper and his closing remarks to signify the hearty appreciation of the Association for the work he has put into it.

We have an allied paper on a similar subject, and you will now give your attention to the reading of the paper on

GAS APPLIANCES,

by Mr. H. K. Morrison, of Concord, N. H.:

We are selling gas, and as sales' agents, superintendents, managers or under whatever name, our business is to create a demand for gas, keep up the demand and keep it growing. In view of this fact it is vital that every one of the various outlets for our product shall be in constant daily use.

We cannot overstimate the good our many friends do for us entirely unbidden and unpaid for, and on the other hand we constantly underestimate the harm a disgruntled customer is always sowing; for it is almost second nature to speak of the bad and not the good in anything. In order to make our customers our friends and get their valuable help it is necessary to do all we can in the line of recommending and selling only the best and most economical appliances for using that which we are selling, Gas. An inefficient article should have no place in our lines of goods. Such will never help keep up the demand.

If we admit the foregoing, then it seems to me that upon the complaint department is a large burden of responsibility in the getting of new business as well as of holding the old, keeping up the demand and keeping it growing. To it belongs the labor of seeing to it that every appliance is in such shape at all times that it will economically utilize that for which it is an outlet, "*Gas*."

In the enumeration of the causes of the many troubles known to us as complaints, we may name two or three which seem to affect our new business.

1. The putting out of poor appliances by ourselves or by others. We would classify under this head poor burners and tips and all appliances so constructed that they are not adapted to our special need. Gas fixture houses and plumbers have a way, for instance, of supplying a three-foot tip for any and all orders. These in a great majority of places are worthless and should never be allowed to be put on fixtures. Alas, they are; and if any one cause exists for the common kick, "poor gas," it is caused by burners not adapted to either the kind, quality or pressure; and it is not a great step from "poor gas" to "big bills," and all kinds of abuse and the loss of an old or prospective customer.

2. Interference by others than employees. There are numerous people who must be tinkering with everything. No matter how carefully we may adjust our appliances, someone, ignorant of cause and effect, there will sure to be who knows better, knows it all, and makes a vital mistake. These troubles generally get to the complaint clerk and are remedied. If not they must be sought out and remedied or again we lose in one or both classes of customers.

3. The poor work of our employees. Eternal vigilance seems to be needed to prevent poor work, improper construction, leaks and all kinds of trouble caused by employees. If promptness in correcting any mistake is necessary in answering trouble of this class it surely should be the invariable rule. Happy the company and numerous its friends whose employees never leave a leak, never over or under read a meter, (Why don't meter makers use an index that can't be incorrectly read?) never talk too much, etc., etc. Inefficient employees, like inefficient appliances, should be the rare exception, if we wish our friends to advertise us.

4. Appliances which need some periodical inspection, under which class I have in mind particularly gas stoves and other large users of gas which have been sold, and presumably in use years without inspection and without complaint. This does not mean, however, that there may not be cause for complaint, or that the stove is even in use at all. I should here like to emphasize the need of a house-to-house inspection of stoves specially; such inspection should be made not by a fitter but by a skilled cook, preferably a woman, who is full of tact and good common sense — one who cannot only detect poor adjustment but improper handling of appliances and suggest methods of economy, and whenever necessary give lessons in the cooking of plain, everyday food. She will get behind the scenes and possibly make some discoveries that will surprise you, and she will do far more good here than before an audience. She may find the ovens not in use or some particular oven universally unsatisfactory. I have known of such a case, as no doubt did every other woman acquaintance in that town within reach, and more than one sale was blocked on account of it. She will find out what a man never could.

I believe the same careful and regular inspection should be made of gas engines by an expert in that line. I know of one

case where a customer tinkered with an engine a whole week and then called in the services of the gas company. It took about ten minutes to set it straight; not only did the customer lose a week but the gas company a week's consumption. An inspection would probably have prevented it.

No doubt much cumulative evidence can be brought out to show the intimate relation of one's old business and how we care for it, to our new business and what it costs to get it. If I have succeeded in merely calling attention to it I believe this attempt will have paid.

Light, heat and power are the three outlets for our product. Keep them before the public in every way possible; yes, but of equal importance, keep every appliance in use in condition to do its work economically, and you will have won half the battle of keeping up the demand, and at the same time will have decreased the cost and increased the profits on new business.

Discussion.

The President—Is there to be any discussion on this paper? It is axiomatic in its character, with good, sound advice. I take it that we all agree with what Mr. Morrison has set forth. If the members will give their attention we will now proceed to call the roll.

ROLL CALL.

The Secretary called the roll, the responses thereto being as follows:

HONORARY.

Col. Frederick S. Benson	Brooklyn, N. Y.

ACTIVE.

Addicks, W. R.	Boston, Mass.
Africa, W. G.	Manchester, N. H.
Alden, G. A.	Watertown, Mass.
Allen, B. J.	Allston, Mass.
Allyn, H. A.	East Cambridge, Mass.
Anderson, W.	Chelsea, Mass.
Barnum, D. D.	Worcester, Mass.
Burritt, D. F.	Portsmouth, N. H.
Coffin, J. A.	Gloucester, Mass.
Coggeshall, H. F.	Fitchburg Mass.

Cook, R. W.	Providence, R. I.
Cooper, A. F.	Exeter, N. H.
Coyle, P.	Charlestown, Mass.
Crafts, H. C.	Northampton, Mass.
Eccles, A. D.	Ware, Mass.
Ellis, J. W.	Providence, R. I.
Erhard, T.	East Cambridge, Mass.
Farnum, G. W.	Lowell, Mass.
Fish, R. H.	Taunton, Mass.
Fowler, S. J.	Charlestown, Mass.
Gifford, N. W.	East Boston, Mass.
Gould, J. A.	Boston, Mass.
Goulding, N. O.	Natick, Mass.
Hassett, E. J.	Beverly, Mass.
Hawken, T.	Rockland, Me.
Hintze, T. H.	Lowell, Mass.
Humphreys, C. J. R.	Lawrence, Mass.
Humphreys, J. J., Jr.	Coney Island, N. Y.
Jenks, Z. M.	Woonsocket, R. I.
Jennings, F. W.	South Framingham, Mass.
Lane, H. M.	Leominster, Mass.
Leach, H. B.	Taunton, Mass.
Learned, W. A.	Newton, Mass.
Learned, C. A.	Meriden, Conn.
Leonard, C. F.	Fall River, Mass.
Manchester, G. L.	Easthampton, Mass.
Mansfield, G. W.	Salem, Mass.
McGregor, W.	Pawtucket, R. I.
McKay, W. E.	Boston, Mass.
Morrison, H. K.	Concord, N. H.
Moynahan, J. F.	Stoneham, Mass.
Nettleton, C. H.	Derby, Conn.
Norton, H. A.	Boston, Mass.
Norton, W. F.	Nashua, N. H.
Norton, P. T.	Nashua, N. H.
Nute, J. E.	Fall River, Mass.
Nutting, C. H.	Chicopee, Mass.
Prichard, C. F.	Lynn, Mass.
Quinn, A. K.	Newport, R. I.
Richardson, F. S.	North Adams, Mass.
Sargent, F. S.	Lawrence, Mass.
Shelton, F. H.	Philadelphia, Pa.
Sherman, F. C.	New Haven, Conn.
Sherman, C. D.	New Haven, Conn.
Slater, A. B., Jr.	Fort Wayne, Ind.
Spaulding, C. F.	Waltham, Mass.
Spaulding, C. S.	Newburyport, Mass.
Spaulding, W. H.	
Spear, J. N.	Boston, Mass.
Stearns, W. M.	Waltham, Mass.
Stevens, C. F.	Haverhill, Mass.
Stone, A. F.	Chelsea, Mass.
Travis, F. M.	New Haven, Conn.
Walker, W. L.	Fitchburg, Mass.
Walker, E. L.	Hyde Park, Mass.
White, C. E.	Wakefield, Mass.
Wood, W. A.	Boston, Mass.

Woodward, R.	Pittsfield, Mass.
Yorke, E. H.	Portland, Me.

ASSOCIATE.

Baker, S. E.	Fall River, Mass.
Barnes, A. M.	Cambridge, Mass.
Baldwin, C. H.	Boston, Mass.
Chaney, F. V.	Boston, Mass.
Coburn, C. M.	Chelsea, Mass.
Cortis, D. T.	Boston, Mass.
Gardiner, W. H., Jr.	Boston, Mass.
Griswold, C. F.	Meriden, Conn.
Hinman, C. W.	Charlestown, Mass.
Holmes, R. E.	Winsted, Conn.
Humphreys, F. W.	New Haven, Conn.
Mace, F. W.	Lynn, Mass.
Norton, A. E.	Boston, Mass.
Scranton, G. H.	Derby, Conn.
Thomas, F. W.	Boston, Mass.
Tufts, J. P.	Boston, Mass.
Waldo, C. S.	Boston, Mass.
Waldo, J. A.	Boston, Mass.
Wilder, C. C.	Springfield, Mass.

The President—We have a few minutes left before the hour for adjournment. Will someone tell

"How near to a gasholder it is safe to have a gas lamp?"

That question is asked in all seriousness. Has anyone got one within twenty feet?

Mr. Coggeshall—I had one within three feet.

The President—Anyone within less than three feet? Is that an inclosed holder?

Mr. Coggeshall—Yes.

The President—And the lights inside?

Mr. Coggeshall—No; lights in the walls.

The President—I suppose this refers to a naked light. Is there any one here who has a holder with a light closer than three feet?

Mr. Nettleton—May I ask if it refers to an inclosed holder?

The President—I am not able to state that.

The Secretary—I suppose not.

Mr. Nettleton—Not an inclosed holder?

The President—I should think it meant where the holder could blow and the ignition of gas or oil take place from the lamp.

The President—We have time left (if you have settled on three feet as the distance) to discuss the question of purifiers. What members have had experience with two boxes of extra depth?

> "Can anyone state of his knowledge which system is preferable, two boxes of extra depth, or four boxes with center seal?"

As I pointed out this morning, you can use purifiers that are equipped with the center seal, under the Chollar system of running the gas backwards and forwards, by turning 45° instead of 90°. It will keep in service the first box in the series, which will still be the first box in the series, only the gas will enter at the outlet, and you will put in service the former idle box, throwing out of service the two boxes which were last in series, provided the eight compartments of the body of the center valve are accurately made.

Mr. Prichard—I might throw some negative testimony on that question. I used during last winter four boxes of extra depth and have been unable to keep the sulphur within the limit required by the law.

The President—We are very glad to get that.

Mr. Sherman—Mr. President, if Mr. Forstall, Secretary of the American Association, is in the room, he can give us some information on that point.

Mr. Forstall—I think one way of looking at that question is this: Unfortunately no purifying material will take all the impurities out of the gas up to the time that it is incapable of working. In other words, you have to keep at least one of your boxes filled with practically clean material. If you have two boxes you have to keep fifty per cent. of your purifying material practically clean; if you have four boxes you only have to keep twenty-five per cent.; if you have six boxes you only have to keep sixteen per cent.

The President—Members will recollect the paper that Mr. Miller read before the Association, showing the amount of

sulphur taken out in the several boxes. Mr. Forstall has condensed a good deal of comment in his statement. Will anybody else contribute to the information asked for?

Mr. Woodward—In our new works we have two boxes of pretty good depth, and have had very good results from them. The company is very well satisfied with their working.

The President—Are you using the coal that Mr. Prichard describes?

Mr. Woodward—We have had trouble with sulphur. But what companies have not had such troubles this winter? We obviate that partly by putting a layer of lime on top of the oxide.

Mr. Forstall—If I may be allowed to speak again, I would like to ask Mr. Woodward what the area of his boxes is, and what amount of gas he is putting through them per day? I have found two box sets do pretty good work, but they were so very large in proportion to the amount of gas they were taking care of that it does not prove anything as to the value of such sets. When those boxes are getting to be worked up to anything like what the capacity should be of four box sets of the same area there is going to be a different story to tell.

The President—I have no doubt Pittsfield looks forward to the growth of business that will make it necessary to change its equipment, or add to it.

Mr. Coffin—I have some facts on purification, and found, from analysis made from different parts of the work, from the different boxes, that it was an actual fact that, with three boxes running (a four-box set), the first box was doing seventy-five per cent. of the work, the second twenty per cent., and the third five per cent. Now, if you cut that down to a two-box set, in my judgment you would lose twenty-five per cent. or thirty-three per cent. of your purification, with the same material.

The President—Will Mr. Woodward reply to Mr. Forstall's question as to the area of the box and the rate of flow per unit of time?

Mr. Woodward—Our boxes are very large for the amount of business we are doing, but it is an old saying that a company should build purifiers as large as it can get money for.

Mr. Prichard—I would like to ask Mr. Woodward if he believes it would be possible to keep within the limits of sulphur required by the State, if he were having an inspection once a week and had two boxes?

Mr. Woodward—Yes; I do. The question rests on the rapidity with which you can change the boxes. The dumping and the conveyers that help you make the change so rapidly.

Mr. Prichard—The point would be that you have to change them so rapidly that the State Inspector doesn't get you.

Mr. Allyn—I wish Mr. Woodward would state the size of the boxes, and what his daily output is.

Mr. Woodward—The size of the boxes is sixteen by twenty by five feet deep.

The President—And the rate of make?

Mr. Woodward—Our make has not exceeded 15,000 an hour.

The President—"Will you state the relation of Texas oil to the gas business at present?"

Has any one in New England used any considerable quantity of Texas oil. Mr. Allen, you have analyzed it, have you not?

Mr. Allen—We use Texas oil as fuel only.

Mr. J. J. Humphreys, Jr.—I suggest that Mr. Shelton answer the question.

The President—Mr. Shelton, will you tell us the use of Texas oil in the South?

Mr. Shelton—Just what is the question, Mr. President?

The President—"What is the relation of Texas oil to the gas business at present?"

Mr. Shelton—Very unsatisfactory, sir. I mean the supply of Texas oil.

The President—And the use?

Mr. Shelton—Very satisfactory. I have used a great deal of it in New Orleans, La., and a great deal of it at Staten Island, N. Y.

The President—How much extra work does it throw on the purifier?

Mr. Shelton—At Staten Island our experience was extremely satisfactory. We found very little increased purification

[illegible] or [illegible] or [illegible]. At New Orleans, where we used the straight crude oil, in no sense refined through any of the [illegible] being taken out, we increased our purifying charges [illegible] five per cent.

The President—Is that Beaumont oil?

Mr. Shelton—Yes, sir.

The President—And what percentage of tar do you get in relation to the oil used?

Mr. Shelton—I cannot give you offhand the exact figures, but it is not materially greater than using the crude oil from the Ohio or Northern fields.

The President—I am sure we are very much obliged for that answer.

Mr. Shelton—I can say that my conclusion is, after having used probably as much Texas oil as any gas interest in the country, that we are only too glad to take it if we can get it in any reasonable supply—at any reasonable cost, independent of quantity—but from the present status of the Texas fields, the tremendous shipments for fuel, the uncertainty as to the future of the fields, and the reluctance of the oil companies to make contracts for what is not above ground, the price in the last few months has gone up very remarkably, and we no longer feel that we can get the cheap Texas oil that one year we did get.

The President—Do you find, Mr. Shelton, that your experience on Staten Island carries out Mr. Norris's suggestion as to cold weather reducing the candle power of gas?

Mr. Shelton—No, sir.

On motion, an adjournment was ordered, to terminate at 2 P.M.

First Day.—Afternoon Session.

The Association reassembled, pursuant to adjournment.

Resuming the Discussion on the Special Report of Directors Regarding the Library Fund, Etc.

The President—The first matter of business before the Association is the Report of the Board of Directors, which was laid

upon the table this morning. What action do you wish to take? If there is no objection, I would like first to read the circular [see page 186] sent out two months ago bringing up the whole matter. This is dated December 22d, "To the Members of the New England Association of Gas Engineers and the Gas Companies of New England." [The President then read the circular.]

Continuing the President said—The report as made by the Board of Directors explains that that sum has been raised, and that if these subscriptions are accepted the largest part of the sum will go to publish the Proceedings. Without this money the Proceedings cannot be published unless you raise the dues. We can issue one more volume, perhaps, by using the permanent fund, but as a settled policy of the Association we cannot continue to publish without raising the dues. It seemed to the Directors that this gave an opportunity in five years to catch up with everything, and then it would be easier to continue the current publication.

[Reading down to the words "Treasury of the Association."]

That is, the annual balance, the excess of receipts over expenditures per annum, will run about $100 to $150.

[Continuing the reading of the report, down to the words "Reprint of Proceedings."]

Any additional subscriptions would be wholly devoted to printing. You understand that we have, however, raised the sum that it was set out to get.

[Concluding the reading of the report.]

Mr. Coggeshall—Mr. President, I am rather thick-headed. I would like an explanation. Is it the idea to print the Proceedings of the Association, from its first inception in 1871?

The President—Not from 1871, but from 1876—the first written and printed record that we have. The list of papers that has been printed will show how far back we can go.

Mr. Coggeshall—How would it do for the different companies that have these volumes to contribute—for instance, our Company say three volumes—so as to save the expense of printing?

The President—The idea was to publish the Proceedings in book form.

[illegible]

The President [illegible] that [illegible] past two [illegible]

Mr. Addak[illegible] $3.75 [illegible] in order [illegible] to [illegible] the Proceedings of previous years so as to make our record complete. The idea of partially occupying a Library, as suggested by the committee, is not without precedent. The American Society of Naval Architects and Marine Engineers have the

privilege of the American Society of Mechanical Engineers' library and building, paying a small sum in a similar way as proposed by our committee. That has worked very nicely. I personally, while not being a member of the Mechanical Engineers' Society, have used that library as a member of the Naval Architects' and Marine Engineers' Society. I want to say, Mr. President, I am thoroughly in favor of the library idea, and also of continuing to publish our current Proceedings and to publish the Proceedings of previous years. I would be in favor of this method of doing it proposed by the committee, if the Association is unwilling to increase the dues to an amount sufficient to care for this matter, without going to the New England gas companies. If the dues were increased to $5, or a net increase of $2 per annum, it would give an increased income of $440 per annum, which is a larger amount than has yet been subscribed for the library fund. I think, as a member of this Association, that the Association should increase the dues for a period of five years, in order to accomplish what the Directors want to accomplish, rather than to accept the subscriptions that have been made by the gas companies. While saying this, I do not want to make it appear that as a member I would be ungrateful in not accepting such subscriptions, but I should think it would be more satisfactory to the Association to take care of the current work of the Association itself. If the subscription is accepted, I think there should be some provision that the company subscribing should have a complete set of the Proceedings furnished it. This does not seem to have been provided in the scheme. I don't care, Mr. President, to make any motion on the lines on which I hope the Association will move, until there may be some further discussion of the matter. We can limit our increase of dues for a definite period, if it is thought best, but in any case I think the annual dues will have to be at least $4 in order to maintain the publication, and I don't think the extra dollar, making a total of $5, is a large amount for any member of this Association to pay. That would certainly accomplish, if I understand the report correctly, everything that the committee would like carried out.

The President—I find from the old records that the annual assessment used to be $10. Then it was lowered to $5, with a large increase in membership. Then it was lowered to $3,

the Association still continuing to increase in membership, and it is at $3 now, with the result that the Association is larger in numbers than it has ever been. I want to correct a slight misapprehension with respect to these subscriptions. While several companies have contributed largely, there have been a great many individual subscriptions from members of the Association. It is not altogether a company subscription.

Mr. Sherman—I would like to ask what the expense of keeping open the headquarters in connection with the Society of Civil Engineers would amount to per year.

The President—We think it would be possible to arrange it for the $100 a year. That would cover everything. The room is open from 9 A.M. to 5 P.M., and a stenographer is there all the time. Anyone wishing to use the library at any other time can purchase a key for twenty-five cents. The room is heated, lighted, and in every way cared for. The $100 covers shelving, heat and everything else.

Mr. Sherman—It is very desirable that we have rooms where we can deposit our books and pamphlets and the different journals which we take. I had occasion some years ago to consult the back numbers of the *Journal of Gas Lighting*. Some of the older members remember the craze that was on about fifteen years ago regarding working with unsealed dips. The company that I represent was threatened with litigation by parties who had secured a patent on that method of working, claiming that we were infringing their patent. In looking over the back numbers of the English *Journal* we found a description of a patent which was taken out fifteen years before that by a man named Cockey, which overthrew all the claims that had been put into the patent office in this country by half a dozen different parties, and set them all aside. If we had not had this information we would have had to pay quite a number of hundred dollars. The claim was very large, and it was set aside by our ability to show that they had not any patent; in other words, it had been anticipated years before by an English patent. It will be very desirable if we can have a reference library, and our members, I think, would have very frequent occasion to consult it. They would find that there was very little new in the world in the gas business.

Mr. Addicks—May I simply add one word in relation to what the President said, that some of the members had individually subscribed. That only means for those individual members that their dues to this Association are largely increased for the benefit of the other members.

Mr. J. J. Humphreys, Jr.—I think that, like the other engineering societies, we should cease to carry around our headquarters in the Secretary's hat and get a place, as most of the other societies have now, where we can have a permanent address and place on file what few papers we own or may acquire. Personally I would be glad to see the dues raised to cover every current expense and to provide some surplus, but also I think that we should get these Proceedings out as quickly as possible.

Mr. Shelton—Mr. President, before that motion is put I would like to speak on this subject. I very earnestly hope that this Association will take some steps to keep abreast of the tendency towards easy access to information that we ought to have on tap. The Association has gotten along very well, it might be said, for thirty odd years without having had any kind of headquarters, and without having any handy information records; but I think the time has come when we should go forward a little bit as we do in every other line; and unless this Association does, the other gas Associations of this country will distinctly outstrip it. And I don't think the New England Association proposes for one minute to play second fiddle to any other gas association. The American Association, in its educational work and through the medium of its secretary's headquarters in New York, has built up an exceedingly good reference library, and there are many men who, when they get to New York, take occasion to look up information that they want on any point.

The Western Gas Association is taking steps—and the work is now under way—for a card index of all the practical papers and articles in recent gas literature, to be distributed to its members, so that, at any minute almost, a man can put his finger on the whole record of the information on any particular point that he happens to be "up against" or to be looking up.

The Pacific Association is taking two or three such steps to advance its work. The Ohio Association is active and progressive in covering more than it originally set out to do. This

Association, I think, has continued to read papers for thirty years, and has not done very much more excepting to build up strength and good fellowship and strong integral factors of general success. It seems to me almost a self-evident proposition that, if we can have a place in the city here where we can look up any technical point or record that we want to, it would be of great use to us.

Scarcely a season goes by without someone wanting to get special information on some particular point. For instance, the question of dry lid purifiers (doing away with wet seals and blowing cups and all that sort of thing) is one that is coming up. High pressure distribution is another growing subject. Inclined retorts, or even the old questions of how to dispose of coke and to increase sales and that sort of thing, are others. A man may be in a town up in the State and figure that he is not getting what he should for his coke. He has a hazy idea that there have been two or three papers on how to market coke, and how to get the best results and work it up, but he cannot put his fingers on them; he cannot get hold of "Gifford's hat;" he cannot tell where the information can be found. If after a season or two we all knew, from hearing about it, that there was a room around the corner in Boston where one could go at any minute and find an index or the complete file of all that has appeared and been written upon the subject, I think there are a good many men in the course of the season who would avail themselves of that and make a particular point to look up what they are after under such auspices.

The expense is trifling it seems to me for the results which would be secured. Personally I am heartily in favor of this move. It does not mean very much money on the part of the Association. After two or three years' trial, as the President says, it can either be dropped or not; but I venture to predict that the Association then would not think for a moment of discontinuing its reference library, and when that library is once started I am sure it will grow rapidly by contributions from different companies, by books that are published from time to time, and by the back record of this Association's paper's, which ought to be compiled and bound and put there for access. It seems to me, however, that there is a very great question as to the proper way of accomplishing this. The

proposed plan is to use the surplus money we have in the treasury, and to avail ourselves of private subscriptions for the balance, the total of which would "pay all the freight" and print the back records—copies of which would go to all the members of this Association whether they subscribed or not. It does not seem to me that that is fair. I know of one member of the Association who has contributed, in addition to his dues, a very fair sum for such purpose, considering his individual salary, and the fellows who don't subscribe, who don't come in on this movement, still get the benefit of what he pays, because they will get copies of the back records, and they will have the full privileges of this meeting room and reference library referred to. The only fair way is for the Association to "pay its own freight."

While questions of affecting the membership, a fear of not getting more people to join every year, and other ghosts of that sort, are thrown up, the practical effect of raising the dues a dollar or two a year would never be noticed, in my personal opinion. The President said that we started here with dues of $10, that they then came down to $5, and that they then came down to $3, and it was suggested that the increased membership was the result of the $3 rate. I don't believe any such thing. I believe that the increased membership has come from the general growth of the business and conditions at large. I believe this Association has more members and is more prosperous than ever, and is doing more work in the way of papers, and is protecting and advancing the gas interests of New England as a result of its publicity and its advertising, its team work, and that its success is due to that rather than to the mere fact of the $3 annual fee. Three dollars is a truly nominal sum, I might say, for membership, in the connections and information and comfort in the business that this Association gives. I believe that we could easily afford an increase. I bear in mind those who have to count every dollar and those who do not. I believe those who can afford to pay $3 and are willing to pay $3 will practically just as readily be willing to pay $4 or even $5. Before a motion is put that the Association should take care of this work (which ought to be done to keep abreast of the times and to amplify the work of the Association) by accepting a subscription of a comparatively small number of the membership for the benefit of all, and putting ourselves in

the position that that implies, we ought to see if it is not reasonably possible to raise the dues a dollar or two, if you please, only for such a time as is necessary to clear up this work and get a good library and see how it works. If we don't like it after three years, or after five years, there is nothing to hinder rearranging then just as far as we please.

The President—There is a precedent—in respect to printing Proceedings and distributing them to members who were not members at the time the proceedings took place—in the Western Association which has been for some years reprinting the back years and distributing them to those who are now members.

Mr. White—Mr. President, as one of the younger members of the Association I have been very much interested in the remarks made, and especially those of Mr. Prichard earlier in the session. I have felt that these proceedings would never be any more valuable than they would at the present time, especially to the younger members of the Association and the gas fraternity. Mr. Sherman has remarked that many had copies of the *American Gas Light Journal* containing the records of the proceedings of the early meetings. He might have asked how many had such copies. I was very sorry that that question was not put, so as to get an expression of opinion along those lines. I feel that the small additional tax on each member for the early publication of the Proceedings would be a trifle compared to the results obtained. I had occasion two years ago to look up some matters, and I went to the Boston Public Library. I spent two hours trying to get some information. A mass of books was brought to me that were of really no practical value for the information which I desired. I am safe in saying that at that time there were few books there that were really up to date along the lines of gas work. I trust and earnestly hope that some definite action may be taken for increasing the dues so that a suitable amount may be raised to publish these Proceedings at once, as I said before, when they will be the most valuable, at least to me. I don't want them five or ten years from now; they would be more valuable today than at that time.

Mr. Shelton—Mr. President, I want to add one word. I think that most of us have not back copies of the *American Gas Light Journal*. I started to bind those that I had the

other day, and I found that I was shy a great many. More than that, the publication of the New England Proceedings is for *convenience*. The old copies of the *Journal* get mislaid. Subscriptions may not have been taken, or the preceding superintendent may have carried the papers away with him to his next place, as they sometimes do. He may consider them his personal property rather than the company's, and sometimes they are. I feel that the fact that the companies in theory have subscribed to the *Journal* for a number of years does not meet the case at all. What we want is a handy compendium of this Association's papers in a bound volume right in our own book-rack. As far as the Association's headquarters is concerned, and the ability to get an index of all the prominent gas articles in the last twenty or twenty-five years, on behalf of the Western Gas Association I herewith present to the New England Association a complete index (when issued this coming spring, in May) of all of the gas literature so catalogued and that has been published in the last twenty or twenty-five years, and with the compliments of the Western Association. [Applause.]

Mr. White—If I may speak again, at the suggestion of one of the members I move an amendment to the motion that has been made that the dues for the next five years be placed at $5.

Mr. Addicks—I second that motion.

The President—The Board of Directors, if I may speak for them, do not feel that they have given you a perfect plan for accomplishing the work that you have in mind. You all seem to want the work done. At all events, we have succeeded in showing that you are tremendously interested in the whole subject.

Mr. Addicks—Mr. President, I move that the report of the Directors be accepted, that the library fund and the publication of the Proceedings be undertaken, that in order to defray the expense the dues be raised for a period of five years from $3 to $5, and that the President and Secretary notify those who have subscribed that this action has been taken and thank them for the assistance that they have given in the premises, but say that the Association will not require the money. [Seconded.]

The President—Are you ready for the question? [Adopted.] It is delightful, gentlemen, to know that we are going to have those Proceedings.

Mr. Prichard—Mr. President, following what I said this morning, the thought occurred to me just now that we have lying idle a sum of $500. I would suggest that you consider whether it would not be wise to use that fund immediately in publishing recent Proceedings of the Association, and make the money good later on. Let us get the benefit of this thing at once, while we are still here.

The President—Will Mr. Prichard make a motion that will authorize the Directors to dispose of the permanent fund in conformity with the general purpose of the publication of Proceedings? It is not necessary, but it would be satisfactory, I think, to the Directors to have their power reinforced in this matter.

Mr. Prichard—I would move, Mr. President, that the Directors be authorized to expend whatever unexpended balance there is on hand at the present time, in addition to the permanent fund, this fund to be made good later from the increased dues, in publishing as many of the yearly Proceedings of the most recent years as it is possible to publish, and that the Board be also authorized to expend any sum which in their judgment is reasonable in employing such help as is necessary to expedite this issue. [Seconded and adopted.]

The President—In soliciting the subscriptions (now a past issue), the Board of Directors had in mind the disinclination that had sometimes been shown to raise the assessment, and it was an endeavor on the part of the Board to accomplish the same work without taking the money from people who might not be able to subscribe. I am very glad that we have reached the same end by standing on our own feet.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Mr. C. F. Prichard, of the Committee on President's Address, read the following report thereon:

To the New England Association of Gas Engineers: Your Committee recommend to this Association a careful consideration of the points brought out on the address of the President. Many of the thoughts suggested can be carried out by every member of this Association with profit to himself and his company.

The address puts before the Association in a clear and concise manner the important events of the past year. A valuable

lesson can be drawn for future guidance, on his note of warning regarding the difficulty of securing future supplies and construction.

The decision of Judge Brown, quoted from at length, should be remembered in the suit for any damage from electrolysis. The determination of the Commission in the Holyoke case given by the President in detail, will probably establish the practice and accordingly should be borne in mind. His recommendation of the publication of the "Proceedings" of the Association is one of vital importance, and some plan should be devised to accomplish this quickly that the members may realize an immediate benefit.

C. F. PRICHARD,
H. A. ALLYN, Committee.
F. C. SHERMAN,

On motion, the report was accepted and placed on file.

TWO TELEGRAMS OF SYMPATHY.

Mr. Barnes—Before proceeding to the consideration of the next paper, I have a suggestion to make to the meeting. I learned today that Mr. A. B. Slater, I think one of the founders of this Association, certainly one of its Past-Presidents and an honored member, and Mr. C. D. Lamson, a man who may be described in the same way, are both sick at home and are unable to attend this meeting. I move, sir, that a committee be appointed to draw up and send, at the expense of the Association, messages to these two gentlemen, conveying to them the greetings of the Association, our regret at their enforced absence, and best wishes for a speedy return to good health. [Adopted.]

The President appointed Mr. A. M. Barnes a committee to send the dispatches.

The President—We will now listen to the reading of the paper on

An Experience with Incandescent Lighting,

by Mr. A. F. Cooper, of Exeter, N. H.

Mr. President and Gentlemen of the Association:

I have not anything new to present you to-day. This paper was written, knowing that a number of gas companies are entering the field of lighting by the use of the gas arc. The questions presented to me, and which I submit to you, are, "Shall we charge a maintenance?" "Furnish them free ot expense!" "Or sell them outright?"

The statements I shall make in this paper may not be correct, but whatever they are I make them, and if they are wrong I wish to be corrected. My object is to find out what you know about incandescent gas lighting before the discussion is over.

We have heard a paper on "How to Collect Bills," and have had discussions about the gas meter, purification, and appliances for selling gas. I think if we could get the incandescent lighting connected with these other ideas, we might possibly have a chain wherewith to hold all our consumers.

One more suggestion I would like to make in regard to the Welsbach arc is, as to the small tube which supplies the pilot light. I think it would be better if made a little larger in diameter, the orifice on the top being small as now, and then have a screw thread to check the flow to suit. My experience has been that these small tubes corrode and choke the supply of gas. I have used electricity for lighting the gas arc for about four years, and found it very satisfactory. I don't know that this can be done without the use of the chimney, but think it can.

The Welsbach arc can, and should be, regulated so as to be practically noiseless.

We do not attempt in this paper to give the exact candle power per foot of gas burned, but the practical manner in which the incandescent gas light may be handled to give the best satisfaction to our customers.

The use of the burner as a general lighting medium; for a library or study lamp; by the grouping together of two or more of these lights, for the purpose of lighting large areas, "The so called Gas Arc."

As a general lighting medium, we mean where there is a general distribution of the burners on chandeliers, brackets or pillars. We use the Welsbach No. 2, or No. 60, with the apple or pear-shaped globe. A large number of these lights will be used on swring brackets. Try and avoid putting one on a partition wall near where the door closes, as the jar caused by closing the door will shorten the life of the mantle. Just the same trouble will occur if you put one on the side of a store window against which the door closes, or up through the center of a window.

ADJUSTMENT.

On the No. 2 adjust the gas check before burning off the mantle. We have a needle of the exact size needed, but a competent man can tell by looking through the tube. If you remove the gas check, when you replace it in the tube have the holes under cover rather than opposite the air ducts. The No. 60 can be easily regulated after you burn off the mantle. We recommend the check now used on the No. 60 and No. 34, as a practically perfect adjustment to pressure can readily be made.

Your consumers can be educated to the use of this check, although some trouble may occur at first. Our pressure varies one inch between night and day. When we adjust to day pressure we leave the mantle one half filled; the upper half will show a light brown color. When the pressure is turned on the mantle will be filled. Keep low rather than high.

Your customers will be better satisfied with a good, fair light and no breakage, rather than a very brilliant light with a constant expense for repairs. The mantles should be put on upright, and after burning off the coating use the Bunsen to clean the mantle, especially the lower part; it looks better and will last longer.

COST OF REPAIRS.

The Phillips Exeter Academy, in November, 1901, had in use sixty-nine No. 34 Welsbach lights and twenty-one No. 2, making a total of ninety incandescent burners. The cost of renewals to December 1st, 1902, was $26.15, not including any labor charges. The first lights were put in May, 1899, twenty No. 34 lights; in October, fourteen, and in November, eight. In November, 1899, we had one charge for renewals,

$0.45. In October, 1900, we put in seventeen more and renewed the lights already in at an expense of $6.55. We used the No. 197 mantle.

For a table or study lamp we use the No. 34, with the eight-inch glass chimney, Nos. 10 by 43 green shades. Some prefer the yellow eye shield; it gives a better light on the table and tones it.

The combination 10 by 43 can be obtained in all colors and decorations. Use the socket drake-neck, not the rubber-lined, for a connection with the chandelier, and the best quality of covered tubing.

COMMENTS.

Before leaving the single burner, we will consider the "Crockery." You cannot call it anything else. The ten-inch dome in colors is suitable for a table lamp as before stated. On a chandelier it looks poorly. The eight-inch crimped is hard to clean, looks badly, and in fact is no good. The eight-inch fluted looks some better, but that is all you can say about it. We have lately seen an eight-inch of the same shape as the ten-inch dome, which is an improvement and is of some use. These comprise the ones in general use and can be improved upon.

THE CHIMNEY.

We prefer the eight-inch glass. The mica may be used when you cannot adjust to pressure, or have a broken mantle. What looks any worse than a mica chimney with a large blister on it? The "Crown Canopy" for chimneys is all right.

THE KERN.

It gives a good light for the amount of gas burned, and has its field of usefulness. No. 151, with stalactite globe and fluted shade, is artistic and will find a ready sale for lighting dining and reception rooms, and is very satisfactory. We suggest to the manufacturers and designers of globes and shades, for single or chandelier burners, something similar; it will give us a change.

THE GAS ARC.

The question is: Shall we sell the lamp, or rent it at a price per month, and with or without maintenance? Many gas

companies are entering this field, and all the information it is possible to get is necessary to success. Before the modern gas arc came to our notice we manufactured one, using four No. 34 Welsbach lights, an alabaster globe, twelve by eight by four, and a Wheeler reflector, eighteen inches in diameter, "especially designed," which we could retail for $10.50. Five of these were placed in a store and maintained at our expense for one year. Three of these lights were burned three nights per week, until nine o'clock, and one night until ten o'clock, and the two lights in the windows until ten o'clock every night.

The ledger figures were:	Dr. to Lamps,
	52.50 int. $5.25
Repairs,	10.23
90,200 cubic feet gas.	

THE HUMPHRIES.

The gas arc now made will consume more gas for the same amount of light than the above named, because you do not use the chimney.

The crown on the top of the globe is unnecessary. It obstructs the lights, and if not removed will not permit the lowering of the reflector enough so as to have the proper effect; that is, throw the light down. The reflector is not flat enough, and in all places that I have noticed they are all too high to be of the use for which they were intended. The burners are good but the top of the Bunsen is too large. It should be of the size to take any cap mantle. The pilot light works well.

THE EAGLE.

It gives a good light. We like the shape of the globe, and the shape, quality and size of the reflector are up to our ideas exactly. The innovation of being able to turn out three of the lights and use only one may add one new consumer to your list. We do not like the wrench for turning on and shutting off the light, but it is an aid when you renew the mantles. The trouble is to find it when wanted. We prefer the chain.

The beautiful and ornamental crown for the top of the globe is for day use and should be advertised as such. For illuminating purposes it is a failure, because when the lights are on, the

shadow cast from this covers the whole of the reflector, and destroys its usefulness. The same error as on the Humphries; the top of the Bunsen is large and you cannot use the cap mantle if you wish to. The burners closer together are preferable.

THE WELSBACH.

The lifting of the globe and shade for the renewal of mantles is all right. The adjustment of the burners is perfect, or perhaps we had better say, the best we have used. The burners are close together and will take any cap mantle on the market. We would suggest a crown canopy to be used as a smoke protector. This would do away with the unsightly ones now used on all the lights before mentioned.

Discussion.

The President—There is in the Question Box a query which we should take up with this subject. It is:

> "Of the gas used for lighting what percentage is used through incandescent burners?"

Mr. Cooper, will you state what it is in the case of Exeter? Will any gentleman give the figures for his town or city, or an estimate?

Mr. Crafts—In connection with the Humphries lamp some of the members may not know that this light is now being made with an electric attachment for lighting. A pilot light is used, but the valve is thrown by electricity. It simply requires a battery. It can be used for window lighting or for high lighting in churches or other places difficult to reach.

Mr. Barnes—I would like to ask Mr. Cooper, or any other gentleman present, whether he has ever noticed or been troubled at all by odor from the gas arc light, as the product of combustion? We have one or two in use in our office, and people coming in there from out-of-doors complain frequently of an odor which they detect where these lamps are burning. It seems to be a pretty well established fact in our case that the odor which people notice is the product of imperfect combustion from the arc lights. I may be wrong in the matter, and possibly some gentleman here can set me right.

The Secretary—I should like to ask Mr. Barnes if he doesn't get the same complaint from the single lights as well. Only day before yesterday I was held up by a man who had just put in one of our new mantle lamps, and it smelled so badly that he was dissatisfied with it.

The President—Has any member any experience as to the effect on this odor (from the Welsbach light) of pre-heating either the gas or the air?

Mr. Fowler—The matter of this smell has, I think, been up before us a good many times. One of our customers last fall told me that the gas was so bad that he really could not stand it and there must be a change. I went out to see him, and found that he was using a cheap form of burner—not a Welsbach—some substitute for it. In the office the air was really very bad indeed. I called it an acetylene smell. I presume it came from improper combustion of the gas. In this case he threw away all the old burners, because he found slight leaks of gas around in various places and could not fix it. He put in new burners, and after that had no trouble at all about the smell. These leaks seemed to be because the burners were not properly screwed on, or the threads were not well made. I was very much astonished to find that that was the trouble, because there was no smell of unburned gas at all, and it was evidently a very small flame right against the branch where the burner was screwed on to the chandelier.

Mr. F. W. Humphreys—Can any of the gentlemen present give us a description of a light which is being exhibited in the Stewart Building in New York, with an inverted mantle? I have heard of it, but have not been able to see it yet. They say it is very effective.

The President—Mr. Cooper, the Association is very much obliged to you for your paper.

TWO TELEGRAMS.

Mr. Barnes—Mr. President, as the committee appointed to draw up a telegram to Messrs. Slater and Lamson, I report that the message prepared is as follows:

"The New England Association of Gas Engineers, assembled at its thirty-third annual meeting, sends you its cordial greeting,

its regret at your enforced absence, and its best wishes for your speedy return to good health."

On motion of Mr. Fowler, the report was accepted and the telegrams were ordered sent.

The President—We will now listen to the paper on "An Electrical Disturbance in the Gas Industry," by Mr. Barnum, of Worcester.

Mr. D. D. Barnum, of Worcester, Mass, read the following paper entitled

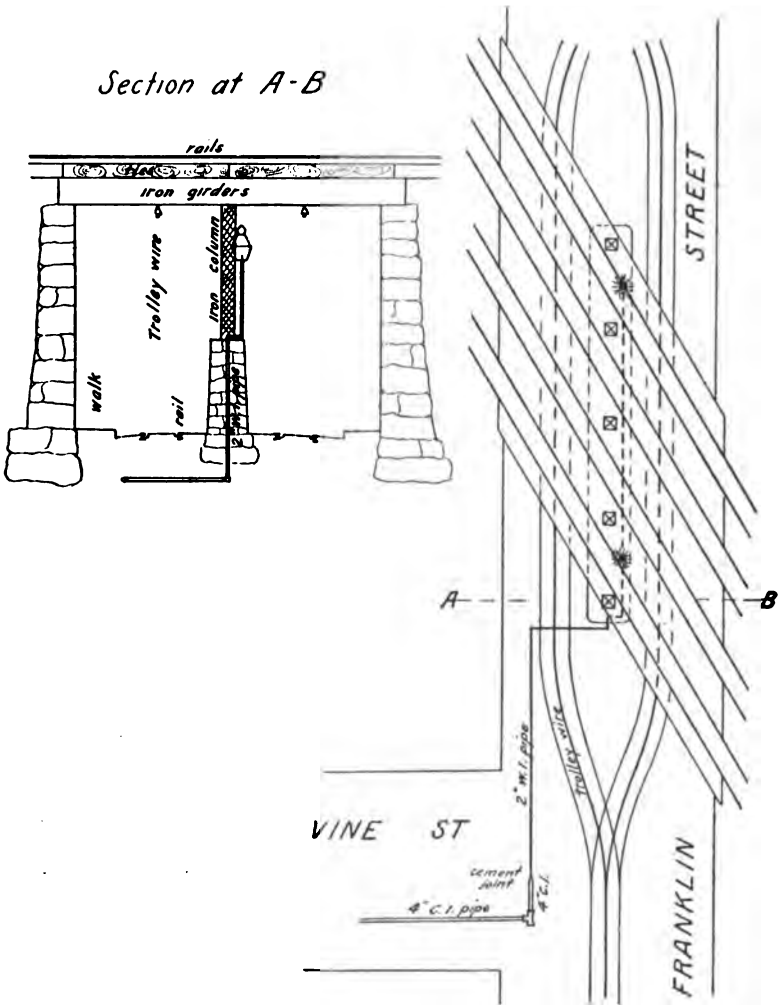
An Electrical Disturbance in the Gas Industry.

An interesting phase often occurs in the gas business when we are called upon to consider not only what has taken place, but what serious things might have happened if there had been a very slight change in some of the factors leading up to the incident.

In the city of Worcester we have experienced considerable trouble during the past few years from street leaks, due to the construction of an additional sewer system throughout the city, and a very large extension of the high pressure water service by the City Water Department; added to these disturbances, the electric light company has laid over twenty-five miles of underground conduit, and the telephone and telegraph companies have also laid extensive underground systems; all in the period of four years. It is not necessary for me to tell you the effects of all this underground work upon our pipes. And yet the most interesting leak of gas was caused by an overhead electric trolley wire.

On February, the 20th, at 10:45 P.M., the Gas Company was notified that there was a leak of gas from its pipe underneath the Franklin street railroad bridge, and that the gas from the leak had caught fire. The workmen arrived at 11:15 and found, on examination, that there was a small hole in the two-inch, wrought iron pipe, where it came in contact with an iron column of the bridge; the pipe was one that was laid along the top of the stone abutment of the bridge to supply some street lights. The men naturally thought it had been worn by friction, and disconnected the pipe near where it left the ground.

The next morning, while I was attending the second day's meeting of this Association, I received a telephone message from



Worcester saying that a considerable section of the city was affected by escaping gas—that a number of reports had come into the office in less than two hours. I hurried back, and

when I arrived I learned that my assistant had found that a majority of the complaints were due to gas coming through an electric light conduit, and that the men had begun to dig a hole near a manhole of the electric light conduit, where the smell of escaping gas appeared to be the strongest; this manhole was near the end of the Franklin street bridge. At that time I learned of the leak in the two-inch pipe the night before. After investigating I had the men start to steam out another place, preparatory to digging, at a point over the cement joint between the two-inch wrought iron pipe, that ran up on the bridge, and the four-inch cast iron which supplied it.

The drawings will show the arrangement of the bridge, how the wires are strung underneath the trusses that carry the steam car rails, and how the street car rails cross above the gas pipe underground.

The cause of the accident, as I have worked it out, was this: A trolley wire hanger fastened to the bridge became loose and the live wire touched on the ironwork of the bridge truss, and the current, between 500 and 550 volts, followed the ironwork of the bridge to the two-inch pipe, jumped the small, intervening space between the two, formed an arc between the column and the pipe and burned a hole in the pipe; this, of course, allowed the gas to escape and the electric arc ignited the gas. The current passed along the two-inch pipe until it came to the cement joint where the two-inch was made into the end of the four-inch; here the current met the resistance of the cement. An arc was formed between the two-inch wrought iron and the four-inch cast iron, the heat of which melted out three feet of the wrought iron, fused the cement into glass and melted some of the cast iron. It can also be seen from the exhibit where some of the current travelled on the two-inch, inside the cement and, jumping to the four-inch, burned a hole in the four-inch about ten inches from its end. This was all done in less than five minutes.

The hole was dug by the men, first thawing the ground with steam. The four-inch pipe was found open at the end and this was plugged. A four-inch hole with three inches of pressure will deliver something like 5,000 cubic feet of gas per hour. The bridge, being on stone abutments, was thoroughly insulated from the ground, with the exception of the two-inch gas pipe; the rails above, for the steam cars, were separated from the iron

trusses by stringers and ties of wood, therefore, the current could not follow this path.

When the current found the two-inch pipe it followed it until it came to the resistance of the cement joint. It jumped the cement joint to the cast iron pipe, simply because at some other point in the city there was less resistance to its getting to the street car rail than there was at this particular point. After it reached the four-inch cast iron it had a fairly good continuous iron conductor to travel on because in a spigot and bell joint iron touches iron, while in the case of a two-inch wrought iron made inside a four-inch cast iron, there is over an inch of space between the two pipes.

It is hard to realize that the melting of the iron and cement all took place in as short a time as it did, but that such was the case was proved at the street railway power house. During the evening of the report of the small leak in the two-inch pipe, at about 10.30 o'clock, the current breaker belonging to the electric line that operated Franklin street dropped out of place, and, for a few minutes, not less than three and not more than five, the switchboard tender was unable to keep it in place, after which it was all right.

The next day the street railway people repaired the broken hanger and "grounded" the bridge in a proper manner.

Discussion.

The President—Gentlemen, this paper has opened up a most important subject. I have no doubt that nearly every manager here has had some unpleasant experience due to the effect of an electric current on a wrought or cast iron gas main. Also the question of leaks is perpetually interesting. Perhaps the Secretary can begin this discussion.

The Secretary—I could say a good deal about leaks, but I think perhaps that I had better not. I do, however, recollect an electric leak, which occurred in New Bedford, somewhat similar to this. A lamp-post was reported on fire. On investigation it was found to be on fire at the top, and a leak was found in the riser after it had been taken out. The supposition was that the pipe had rusted out, but on examining the riser afterwards a hole about the size of a pea was found burned

through the pipe, and no other mark appeared on it. The question came up how that hole got there. The position of the hole was perhaps three feet above the surface of the ground inside the cast iron post. Investigation, however, developed that the trolley guard wire at that point had broken, and coming down the end of it had apparently swung against the post, as a closer investigation showed a slight burn on the outside of the post, just about opposite where this hole was found in the riser. The current evidently during that contact of the wire with the post jumped from the post to the riser and burned a hole through. It seemed a little strange that the current should not have gone down the post into the ground rather than jumping across and taking the riser, but such was the fact.

Mr. Nute—An experience we had about a week or ten days ago from a fire in the cellar of a grocery store is rather interesting. It is the second case of the kind this winter. The grocer had been using electric lights perhaps two or three years ago, and had been using gas for the last couple of years. The switchboard was left there, but the lights had been entirely taken out. I suppose the switch was off at that point, but we had the switchboard, unfortunately for us, right beside the meter, and we got a fire there, which without any question from the evidence was caused by the burning out of the switchboard. The meter was burned up. In the other case the switchboard was so far away from the meter there was no gas fire, but the switchboard was as thoroughly burned out in the first case as it was in the second one.

On motion of the Secretary, a vote of thanks was passsed to Mr. Barnum for his paper.

Another Dip into the Question Box.

The President—In connection with what we have been discussing this afternoon, we might consider another question on the list. It is:

> "What is the experience of members in maintenance of incandescent gas lights for a fixed price per month?"

Mr. Cooper made some statements showing what a large revenue can be had with a proper installation. What is the cost

of maintenance of incandescent lights? Is there any manager of a company here that does this habitually?

Mr. F. W. Humphreys—In New Haven we maintain lamps on that plan. We sell the lamps outright, or we rent them to the consumer charging a rental which rather tends to make him desire to buy the lights. The rental is fifty cents per lamp per month for nine months of the year. We don't send him any bill for the months of July, August, or September. When we sell the light we charge $10 for the four-light Humphrey. We maintain them for twenty-five cents per lamp per month, charging only nine months of the year, omitting the charge in the summer time when they are not using their lights much, and when on very slight provocation they might throw the lights out. Without very much canvassing on the maintenance, or with practically none, we have been able to secure one-half of the number of lights which we have placed at the rate of twenty-five cents per lamp per month. We clean them for that twice a month, furnish whatever mantles are broken, and keep them up in good shape. The arrangement is very satisfactory to the consumers. I believe that with a small amount of canvassing we could reach a point where we could have on maintenance at that rate about three-quarters of the lamps that we have in the city. We have out at the present time over 800 lamps, which are sold at $10 or $9, according to the size of the light, and we have on rental only seventy. I do not consider the rental proposition at all attractive, where the lamp can be sold. I believe that the lamp might better be sold at a lower price and maintenance carried on rather than rent it. The likelihood of some lamp which might be an improvement coming along would leave a stock of junk on the gas company's hand, which would be something equivalent to the Lungren light in the past.

Mr. Woodward—Does the twenty-five cents cover the cost?

Mr. F. W. Humphreys—No; the twenty-five cents does not cover the cost of cleaning twice a month and mantles. The cost is about thirty-five cents; but the loss is money well spent, we think.

The President—Mr. Gould, can you give us figures with respect to the maintenance of the burners in Boston?

Mr. Gould—We are not doing anything in supplying and maintaining mantles. We have not gone into that at all, but have been looking for a good outside gas arc light.

Mr. Crafts—We have a small maintenance system; that is, where we have a store or place of business and the burners are working poorly because they are using cheap mantles, and we cannot get them to use good mantles, we try and get them on a maintenance system. The expense varies very materially according to each proposition, and my experience has been that it will vary from thirty-nine cents to something over $1 per burner per year. We have for about five years maintained the lights on public buildings, and on perhaps 300 burners the cost has been about forty cents per burner per year.

The Secretary—I will admit I put this question in the box myself. I was personally interested in it. It seems to me that where a gas company is in business by itself it would be for many reasons desirable that it should, if possible, control the manipulation of the incandescent burners, especially in the stores. I suppose all of you have looked into places lighted up by gas, both incandescent and ordinary burners, and seen conditions enough to discourage anybody in the use of gas as a lighting agent; but if you tell these people that their burners are poor, that they need new mantles or new burners, the chances are you will be suspected of wanting to sell new burners, or to cover up something in the quality of your gas or of your service of gas which you don't like to have appear. I have repeatedly been ashamed of the appearance of the gas for the making of which I was responsible, when it was no fault of mine that the customer was not getting good light; but when the light is bad the "gas is bad," as far as the customer thinks, no matter what he might know if he looked into it. It seems to me that even if, as Mr. Humphreys has said, the work was done for less than it actually costs, it might be a case where a loss was a good gain. I had hoped to have found a little more about the cost and the amount of this work that was being done. In this connection I might say I had a sample of mantles sent me guaranteed for three months, and as an inducement to buy them it was held out that the maintaining of incandescent lamps was now a very general feature of the gas business, and that if we used these mantles guaranteed for three months, why during that three months the cost of replacing mantles would be very small.

The President—I think the Gas Appliance Exchange in Boston charges about twenty-four cents per week per lamp for

maintenance. That is about $1 a month, $12 a year, for everything in the arc light or cluster light. The Secretary devises questions that get answers. Mr. Humphrey's reply was a consideration that is not generally accorded to the Question Box. Another question is:

> "What are the proper temperatures at which to operate the various parts of a coal gas plant?"

Will any one undertake to schedule the temperature at which such a plant should be operated? Can any of the members give references to articles that discuss this question?

The Secretary—I think, with reference to the temperature at which purifying boxes should be operated, our records will show information given by our present President in regard to that matter. I cannot now refer to the date. In regard to the condensers, I would say that the works which I now have charge of have a long stretch of foul main, which is more or less exposed to the influence of the outside temperature, although the main is not out-of-doors, and during the past winter, or the winter which is not past to-day, I think without exception on every one of these cold snaps that we have had our candle power has dropped with apparently no other cause than the freezing or the loss probable in this foul main and condensers. I have put a jacket on it now, and hope during this cold snap it will hold up better.

Mr. Fowler—I am perfectly willing to tell how I am running the works that I have charge of. The machinery between the foul main and the purifying boxes consists of the exhausters, a Walker tar extractor—three stories—a condenser, which is in use with air only, and a standard scrubber. The gas enters the exhausters at a temperature of about 100°, ordinarily. It is between 94° or 104°. I don't test the temperature again until it comes out of the condenser, at which place it is from 76° to 84°. The gas remains then in that same warm room and is carried underground to the purifying house. In the purifying house the cellar is kept very warm, one single steam pipe running around under each of the four boxes, so that the gas in the boxes is kept warm; but the exact temperature I have no means of knowing. The gas is not ordinarily cooled below between 75° and 80° until it gets into the holder.

The Secretary—I would like to ask Mr. Fowler if he makes any attempt to keep the first box in his series of purifiers warmer than the succeeding boxes.

Mr. Fowler—No attempt at all.

Mr. J. J. Humphreys, Jr.—I think Mr. Barnum is not hunting for trouble, but if we asked him he could tell us exactly the percentage difference in the efficiency of the purifiers with lower and higher temperatures.

Mr. Barnum—I don't think I can give that exactly, because we are running two sets of purifiers in parallel, and it is hard to tell, on account of the varying back pressure in the two series, how much goes through each set. We run the temperature over 80° in our boxes, but don't let it get over 100°. Our oxide will take out about eight per cent. of its own weight of free sulphur each time it is used; in six or seven times that would give about fifty per cent., which uses up the oxide. We purify, I think, about 20,000 to the bushel in that time, which will make it about 150,000 to the bushel before it is sold.

Mr. J. J. Humphreys, Jr.—Will Mr. Barnum give the previous number of grains per use of each batch of oxide to compare with the present number of grains of sulphur removed?

Mr. Barnum—Well, that is rather a difficult thing to give. In mixing coal and water gas, as we do, the mixtures will vary, of course, at different times of day, and if you count on 200 grains in 100 feet of water gas and 400 grains more or less in coal gas, that will give you about 300 to 400 grains to 100 feet entering the purifiers. Running the three boxes as we do with one off box, at the outlet of the first box you will have about 150 to 200 grains, and at the outlet of the second box you will have less than twenty. There are ways for determining the sulphuretted hydrogen, but it cannot be determined with rapidity within twenty grains. I cannot give the proportion it was before when the temperature was low.

Mr. Coggeshall—We manufacture strictly coal gas. In our system of condensation we run a pipe around the retort house once and a-half from the outlet of the hydraulic main to the outlet of the building. We run it across the street (which is about forty feet) boxed up to the exhauster room. At the exhauster room the pipe entering the exhauster is 120°, say, at this time of year. After passing through the exhauster it goes

through the tubular condenser and the water is reduced to about 75°. Then it goes through the scrubber and tar extractor, where it accumulates about 3°, so it is about 78° on leaving the scrubber. From there it goes to the purifiers. The temperature at the purifiers, of course, I don't know.

The President—Mr. McGregor, will you give us your schedule of temperature?

Mr. McGregor—Well, it has not differed very much from what the other gentlemen have given.

Mr. Hintze—In Lowell the exhauster is placed after the condensers. The gas is pulled through the condensers and the tar extractor before it gets to the exhauster. One condenser is used as a sort of an air condenser. It enters at about 120° and drops about 10° through that. It then goes into the tar extractor, and from there through the multitubular condensers before it reaches the exhausters. At the outlet of the last condenser we aim to keep it at 70°. What it is beyond that I have no means of knowing; rather, I have means of knowing, but I have not the figures at hand.

The President—Mr. Allyn, can you give us the practice at Cambridge.

Mr. Allyn—I wish I could, Mr. President, but the chaotic state in which our works has been for the last year prevents it.

The President—A gentleman who has just come into the room will furnish us with information on this point in detail. Mr. Learned, will you kindly state for the benefit of the members the proper temperatures at which to operate the various parts of a coal gas plant?

Mr. W. A. Learned—Give it up.

The Secretary—Mr. President, I would like to move as an amendment to his reply that he give the temperature at which he operates his.

The President—That is what has been done, Mr. Learned. The members have been giving the temperatures that they observe in their own works. Will you kindly contribute your observations of temperatures in your works, from the retorts to the station meter?

Mr. W. A. Learned—I will try to.

The President—The order of the gas and the temperatures.

Mr. W. A. Learned—At the hydraulic main about 135°; at the air condenser 115°.

The President—Are these inlets or outlets?

Mr. W. A. Learned—Inlets. Then comes the exhauster, then a water cooler. At that water cooler the inlet temperature would be about 90°. Then comes the washer, and that would be about 75°; then the standard scrubber, 68° or 70°. After the standard scrubber, we increase the temperature of the gas through a heater, on the inlet pipe of the purifier. That 100° would be in the first box. In the second box there would be a gradual decrease, until just at this present time at the station meter it is somewhere in the neighborhood of 70°.

The President—Thank you, Mr. Learned. I think we are getting capital information out of this.

Mr. Allyn—May I ask Mr. Learned, in connection with that, if he puts his gas into his holder at 70°, whether it does not show a large depreciation at this season of the year?

Mr. W. A. Learned—At the station meter it is about, I think, at the present time 70°. And the station meter under that condition would be two per cent. fast—that is, one per cent. for every 5°.

Mr. McGregor—I might be a little more exact by stating, Mr. President, that the gas from the hydraulic we find varies from 120° to 135°, due to the foul main passing around and through a room which is more or less exposed to the outside temperature, but it enters into the primary air condenser at 120°, passing through the exhauster into the P. & A. no lower than 110°, as we get our best results from our P. & A. tar extractor at that point. Then it enters the secondary air condenser at 100°, and from there we have a regular drop of about 10°, then to our water tube condenser, 90°, into our rotary scrubber, 80°, and splasherwasher at 70°. It leaves the condensing room at a temperature of 65°, and after going through the purifiers, which are rather crowded at present, we have at the outlet of the station meter from 65° to 68°.

Mr. Sherman—Our gas enters the exhausters at 132° It passes through the multitubular condensers and standard scrubber, and arrives at the purifiers at 75°. We keep the purifying house heated up to 70° and 72° all the time. And here I

would like to impress upon the members what I have stated here before several times, that the secret of using oxide successfully is to keep the room warm, and to keep the oxide warm, as it is practicable to do. At the station meter, which is several hundred feet away from the purifying house, we register the gas most of the time at 70°, and, of course, when we make up the accounts that is corrected to bring it down to the normal temperature of 60°.

Mr. Barnum—I would like to have you ask how many of the companies correct their station meter readings to 60° at any given period in the year?

The President—Will those who do this be kind enough to raise their hands? Will those who do not make any such correction at any time of the year raise their hands? They seem to be in the majority greatly—two to one.

The President—We have an allied question here. It is:

> "At what point in the works should coal gas and water gas be mixed?"

Will those who run combined plants briefly state just where they mix the gases? Mr. Barnum, where do you mix the coal and the water gas?

Mr. Barnum—At the inlet of the exhauster.

The President—Mr. Learned?

Mr. W. A. Learned—At the inlet of the purifiers; but hereafter it will go into the hydraulic main at a temperature of 130° or 140° and both mix together there.

The President—The proposed change there is more like your system, Mr. Barnum.

Mr. Allyn—We mix ours at the inlet of the purifier.

Mr. Sherman—We mix our coal and water gas at the outlet of the purifier. We have two separate sets, one for water gas and one for coal gas.

Mr. Africa—At the inlet of the purifiers.

Mr. Hintze—And we do the same.

Mr. McGregor—Likewise.

Mr. Barnum—In connection with this it is well to ask, in considering the mixture of the two gases, do they run them both at the same temperature, or, as is the case with Mr. Sherman,

where he has two separate works, do they condense the coal gas at a lower temperature than the water gas? In our plant we condense the two together; the crude water gas comes from the relief holder and the coal gas comes about 250 feet from the retort stack. The carburetted water gas first goes through small condensers and leaves them at 140°, then it passes through larger condensers, and the outlet temperature is held between 100° and 110°. From here the gas goes to the reliet holder, then to the meter and finally to the inlet of the exhausters, where it meets the coal gas from the retorts. The water gas enters the exhausters at a temperature of 75°, and the temperature of the coal gas is 125°. Mixing about half-and-half, the resulting temperature will be, of course, about 100° at the outlet of the exhausters. The gas then goes through very large air condensers, and at the outlet of the condensers the temperature is held between 75° and 80°. It then goes through a single-seal, tar extractor, and the temperature remains between 75° and 80°.

From the extractor it goes through the scrubbers and the temperature still remains 75°; it then enters the purifiers at 75° and leaves at 80° or more. From the purifiers it goes to the meter and is measured at a temperature of from 67° to 70°. It then goes to the holder, and it is difficult to say just what the temperature is at this point. The water at the top ot the tank remains between 55° and 60°. It passes the governor at between 52° and 60°. Our object is, in mixing the two gases in this manner, to take out the heavy tar while it is hot and to have the two gases mix together at such a time that the vapors in the coal gas that are not in the water gas, and which the water gas can absorb, and the vapors in the water gas, ot which there are none in the coal gas, and which the coal gas can absorb, will be taken up by the respective gases. The advantages we think are as follows: A quantity of vapors is absorbed and carried by the mixed gas that would otherwise be lost; the resultant vapor tension is much higher, and a larger amount of hydrocarbons is carried in the gas, both in the form of gas as well as in the form of vapor. This results in higher candle power. It also gives more vapors for dissolving naphthaline, and, again, the higher vapor tension will carry further in the distributing system.

The disadvantages are that you must have rather larger apparatus, especially scrubbers. You must have in either case about the same amount of condensing apparatus, and the tar extracting apparatus will be about the same. In the case of coal gas you will have a Walker tar extractor, and for water gas some form of sawdust scrubber, especially if your connections are not large and long. The purifiers should be about the same. It, therefore, is evident that the scrubbers only must be larger when the two gases are cleansed together. The real disadvantage that comes in the scrubbing process is that we do not get such strong liquid for shipping which results in larger freight bills; we get just as many gallon-ounces. We obtain over 220 per ton of coal, and I believe 240 is the limit. Another disadvantage might occur if all the tar were not taken out before it reached the purifying material. The efficiency of our oxide does not show that it is affected in the least. We purify about 150,000 to the bushel. It cannot be expected that a plant designed to take care of one million of coal gas, will take care of one million of coal gas with one million of water gas added to it; the apparatus must be as large as would be designed for two million of coal gas, and must have large connections throughout.

There is a great deal of prejudice against running the two gases together, which is probably due to engineers having been forced to do this very thing. To determine the advantage gained in candle power from running in this manner is an exceedingly hard problem. Shall we test the sixteen-candle power coal gas, the twenty-candle power mixed gas and the twenty-four-candle power water gas all with the same burner, or shall we use different ones? The difference in efficiency of the burners might be more than the difference between the actual value of the gases. In testing these three gases we get the most satisfactory results by using an Argand burner and adjusting the flame to give the best efficiency, and then correct to five cubic feet per hour. Dr. Love has determined, I believe, that a coal gas and a carburetted water gas mixed cold, after being purified separately, gains one-half candle, due probably to a better ratio between the hydrocarbons and the diluent gases. Our results in general show an increase of one and one-half candles in the mixed gas above what it should be, if figured from the proportional candle powers, which would show

one candle gained by mixing hot over and above the one-half candle gained by mixing cold.

Mr. Leonard—How does Mr. Barnum raise the temperature of gas that passes through the purifiers?

Mr. Barnum—All our exhaust steam from five engines and two pumps passes through the cellar of the purifying house and the pipes are coiled around the bottoms of the boxes. Besides that, we also have live steam pipes; in extra cold weather we turn live steam into the house. It is simply by having a lot of steam and keeping the boxes very warm.

Mr. Leonard—Do you turn the steam directly into the boxes?

Mr. Barnum—No; not into the boxes. We do it the same as you would heat any building.

Mr. Leonard—You don't turn the steam into the gas at all?

Mr. Barnum—No; no connection.

Mr. W. A. Learned—I should like to ask Mr. Barnum in regard to his temperatures where the water and the coal gas are mixed at the exhauster.

Mr. Barnum—What they are when they enter?

Mr. W. A. Learned—Yes. What are they?

Mr. Barnum—The water gas coming from the holder is about 70° to 75°. It is metered between the relief holder and the exhausters. The coal gas is about 125° coming from the stack, about 150 feet away.

Mr. W. A. Learned—As I previously told you, we are about to put forty per cent. of water gas into the hydraulic main. The temperature of the water gas will be in the neighborhood of 130° or 140°, and that will be the same temperature as the coal gas at that point. In regard to heating the gas in the purifying house, instead of heating the house itself we enlarge the inlet pipe to the purifier; in other words, we put a heater in the inlet pipe and charge it with exhaust steam. That brings the temperature of our gas at the inlet of the No. 1 purifier to 100° or 105°. We find that is better; no, I won't say better, but easier to do than to heat the whole purifying house.

The President—I think the members have answered also another question which was asked here:

> "Does a mixture of coal gas and water gas give a higher candle power than would be computed from the known proportions and candle powers of the component gases?"

Mr. Barnum stated that this system of mixing gave him, as I understood it, one to one and one-half candles more than would be expected by a proportional computation. Another question which deals directly with this general subject of condensation is:

> "What results have been obtained from a P. & A. tar extractor for a coal gas works of 80,000 to 100,000 daily capacity?"

Has anyone had experience with that particular size of P. & A. tar extractor? How many members in the room have P. & A.'s in service doing good work? They will please raise their hands. There are three hands raised. The gentleman who asked the question is here. He knows that the P. &. A. is doing the work for which it is designed. How many have the P. & A. in service and not doing satisfactory work? It seems to do all right.

The Secretary—Mr. President, before that question is dropped, I would like to inquire of some of these gentlemen who have so carefully noted their temperatures, and especially those who have P. & A. condensers, whether they have found that, when the temperature ran above 110°, there was any disadvantage in the higher temperature.

Mr. McGregor—No, I would reply that we never found any disadvantage if we did not run higher; but of course we found that the best practice was to keep the gas at about 110°.

The Secretary—Not below that?

Mr. McGregor—Not below that. In that way, in testing out for tar, we found very little tar on the other side of the P. & A. extractor.

Mr. Nettleton—I would like to ask Mr. McGregor if he uses the P. & A. on water gas.

Mr. McGregor—On coal gas simply.

Mr. Nettleton—Then I should like to ask him if he has had any trouble from naphthaline in connection with it. When the P. &

A. condensers were first introduced, I think almost everybody that put them in had a great deal of trouble from naphthaline, and judging by the reports that have come to us from England they believe it is now due to the fact that the tar was removed and it did not have a chance to absorb the naphthaline out of the gas. There was a paper read recently in England in which it was proposed to put some of this tar back into the gas—not in the vapor, but in a stream—let it go running through a series of pipes, for the purpose of absorbing the naphthaline. I would like to ask Mr. McGregor if he has had any trouble from that source?

Mr. McGregor—We have had this apparatus in use about a month, and I presume the P. & A. is on very good behavior. I can tell Mr. Nettleton a year hence very much better whether we are encountering troubles and difficulties such as he has outlined.

Mr. Allyn—I will state that I have a beautiful P. & A., nearly as high as this room, that I have not been able to use as yet, because it is not connected at either end. I hope to be able to do so the coming year.

List of Books given by Mr. Frederic Egner to the Library of the New England Association of Gas Engineers—February 18, 1903.

The President—I would like to interrupt the ordinary course of business to make a statement, by reading this note from Mr. Frederic Egner which has been handed to me:

To the New England Association of Gas Engineers:

In memory of pleasant reunions with the New England Association of Gas Engineers, I donate to its proposed library the following books:

(*a*) The Law of Incorporated Companies, Operating Under Municipal Franchises. By Allen Ripley Foote, and Charles E. Everett, editing attorney; with resident attorneys as co-editors, in all the States. Three volumes.

(*b*) Digest of the Decisions of Law and Practice in the Patent Office. By D. H. Rice and L. C. Rice. (Rice-Beach.) Two volumes in one.

(*c*) Robinson on Patents. By William C. Robinson, LL. D. Three volumes.

(*d*) Text Book of the Patent Laws of the United States of America. By Albert H. Walker, of the Hartford Bar. One volume.

(*e*) Appletons' Cyclopædia of Applied Mechanics. Two volumes.

(*f*) The Analysis, Technical Valuation, Purification, and Use of Coal Gas. By W. R. Bowditch, M. A., F. C. S., etc. One volume.

(*g*) A Practical Treatise on the Manufacture and Distribution of Coal Gas. By Samuel Clegg, Jr. Fourth edition. One volume.

(*h*) King's Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas. Three volumes.

(*i*) Fuel, Its Combustion and Economy. By D. Kinnear Clark, C. E. One volume.

(*j*) A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches. By George Lunge, Ph. D., F. C. S., etc. Three volumes.

(*k*) Dynamo-Electric Machinery. A Manual for Students of Electro-Technics. By Sylvanus P. Thompson, D. Sc., B. A., etc. Third Edition. One volume.

(*l*) The Guide Framing of Gasholders and Strains in Structures Connected with Gas Works. By F. Southwell Cripps. One volume.

(*m*) A Treatise on Masonry Construction. By Ira O. Baker, C. E. Sixth Edition. One volume.

(*n*) A Handbook of Industrial Organic Chemistry. By Samuel P. Sadtler, Ph. D. One volume.

(*o*) Encyclopædia of Chemistry. Theoretical, Practical and Analytical. By writers of eminence. (Lippincott's Pub.) Two volumes.

(*p*) A copy of Field's Analysis of the Accounts of the Principal Gas Undertakings in England, Ireland and Scotland. Pamphlet form.

(*q*) The Standard Electrical Dictionary. By T. O'Conor Sloane, M. A., etc. One volume.

(*r*) A Treatise on the Distillation of Coal Tar and Ammoniacal Liquor, and the Separation from them of Valuable Products. By George Lunge, Ph. D., F. C. S., etc. One volume.

(*s*) Keister's Corporation Accounting and Auditing. Designed for the use of Book-Keepers, Accountants, Financial Experts, Business Men, Investors, Stockholders, Corporation Officers and Lawyers. By D. A. Keister. (Seventh edition). One volume.

(*t*) Roof Trusses. Revised Edition. Graphical Analysis of Roof Trusses. By Charles E. Greene, A. M., C. E. One volume.

(*u*) Gas Works: Their Arrangement, Construction, Plant and Machinery. By Frederick Colyer, C. E.

(*v*) The Economical Gas Apparatus Construction Co.'s Illustrated Catalogue.

(*w*) The Lowe Standard Water Gas Apparatus. By the United Gas Improvement Company.

(*x*) Proceedings American Gas Light Association. Eighteen volumes.

(*y*) American Gas Light Journal. No. 61–69 inclusive. Nine volumes.

(*z*) A Handy Book for the Calculation of Strains in Girders, and Similar Structures. Consisting of Formulas and Corresponding Diagrams with Numerous Details for Practical Application. By William Huber, C. E.

The Secretary—Mr. President, I move that this contribution to our proposed library be accepted, with the sincere thanks of the Association to the man whom I am sure we each and all individually regard as one of our very best friends.

Mr. Africa—I am pleased to second that motion, Mr. President. [Adopted.]

The President—Mr. Egner, you have the hearty thanks of the Association.

There is I think time to discuss one more of the remaining questions. For instance—

> "What results have been obtained with 'gas oil' in fixing retorts?"

We have had such capital replies to all these questions that I hope you will keep up the good work. I know Mr. Cooper will say a little. He has not had success, I think.

Mr. Cooper—No success.

The President—How many are using gas oil in retorts with entire satisfaction? Will they please raise their hands? How many are using cannel with entire satisfaction? How many are using gas oil without entire satisfaction in retorts? (Laughter.) Mr. Allen, yours is not coal gas.

The Secretary—I suppose that the intent of this question was, in water gas process, not fixing the retorts, but fixing the oil vapors and mixing them with water gas for enrichers, rather than their use for enriching coal gas. I do not now recall who sent in the question.

The President—That is a new interpretation of the question. The only gentleman who mentioned Wilkinson retorts said that he was not using gas oil satisfactorily, so I suppose his results are not worth being disturbed about.

Mr. Fowler—Mr. President, I beg to differ.

The President—There is one more question. It is:

> "What results have been obtained from the new generator fuels used because of the coal strike?"

Mr. Barnum—We have only tried one other fuel besides coke made from good coal. We tried petroleum coke. The difficulty we had—we were running up and down steam at that time—was that when it gets incandescent it flies off in particles about the size of a pea, and with a very strong blast those particles are carried over into the water-cooled valve and also the valve at the bottom, and when you come to shut the valve it does not close. That is the trouble we had with the petroleum coke, so much so that we only used a very small proportion of it mixed with regular coke. I imagine it would work all right in a set without up and down steam. Some companies I know have used it with great success.

Mr. Leonard—We got a cargo, and found we had to screen almost all and could use only about sixty per cent. of it; the remainder had to be used under the boilers. I found that in a given time it would make about sixty-seven per cent. as much gas as Buck Mountain anthracite, including the time for cleansing. It does not ignite as freely as Pennsylvania anthracite, and as a result it is necessary to have shorter runs. Also, it does not clinker as hard.

Mr. Allen—We bought some Welsh anthracite, and started in to use about thirty per cent. without screening it, mixing it with American anthracite. We tried fifty per cent., but found we would be obliged to screen it. We are now using about fifty per cent. of Welsh anthracite, screened. The fine coal we use under our boilers, mixing it with other coal. We get the best results in that way.

The President—We found that, using Welsh anthracite mixed half-and-half with American anthracite, we did very well.

Mr. Allen—Without screening?

The President—Taking the lump. When we took more than fifty per cent. we were not so well satisfied. In the case of retort coke that had been handled four times before it was put into the generator (making the fifth time when it was thrown in), having a large percentage of breeze and dust, we found that for a given weight delivered we could get seventy-five per cent. of the gas that the same weight of clean anthracite would give us out of the apparatus. The coke was not all used in the generators. The rest of the coke would have to go to the boilers. In connection with this subject of petroleum coke I received a letter from Mr. E. C. Jones, who is a member of the Association, now resident in California. He says that petroleum coke is claiming a good deal of his attention, and that he has succeeded in producing a hard metallurgical coke as a bi-product, which contains only one and one-half per cent. ash and no sulphur. That ought to be pretty good material for making gas. The hour for re-assembling tomorrow morning is ten o'clock. We have two papers of importance to discuss at that time, and I hope members will be prompt.

On motion the Association adjourned, to re-convene at ten A.M. the following day.

Second Day—Thursday, February 19.

Morning Session.

The Association met pursuant to adjournment. A special report from the Board of Directors, relating to the election of some belated applications for membership, having been favorably acted upon, the President announced that the Association would listen to the paper, by Mr. A. B. Tenney, of Revere, Mass., on

The Development of the Gas Distributing System of the Suburban Gas and Electric Company in Revere and Winthrop, Mass.,

which was as follows:

In the early part of 1901, franchises to sell gas in the towns of Revere and Winthrop were granted to the Suburban Gas and Electric Company. In years previous various attempts had been made by local parties in both towns to obtain franchises, but as these attempts did not result in any form, the field opened up by these franchises was free from competition and offered to the promoters an excellent chance to see what could be done.

The combined population at this time was about 16,000; 10,000 in Revere and 6,000 in Winthrop. These figures are greater during the summer months, and the combined population in July and August could be safely placed at 22,000.

The property of the Suburban Gas and Electric Company is located on Chelsea Creek, Revere, directly adjoining the depot and freight yard of the Eastern Division of the Boston and Maine Railroad, and is thus amply provided with good means for obtaining coal and necessary articles of manufacture at the lowest possible prices. Plenty of land for buildings is available; thus the location offered excellent opportunities for the

construction of a gas plant, but after carefully considering all these points, together with other available sources of supply, it was finally decided to abandon the manufacture of gas for the present and to purchase same of a neighboring company for a term of years, and thus merely maintain a distributing system.

The Company agreed with the local authorities to lay a maximum of seventeen miles of pipe, six miles in Revere and eleven miles in Winthrop, before July, 1902; to sell gas at \$1.20 net per 1,000 cubic feet, and to reduce this price to \$1.15 per 1,000 cubic feet in about eighteen months after the granting of the franchises; also, to reduce the price of gas to \$1 per 1,000 cubic feet as soon as the average consumption per capita became equal to that in the State of Massachusetts.

One other condition imposed upon the Company by the Revere authorities was that citizens should be hired when possible to do the work of construction, and that they should be paid at the rate of twenty-five cents an hour, a most unreasonable price for labor of this nature. In order to induce the people to use gas the Company offered to lay services, not exceeding fifty feet, to set meters and connect same to gas ranges or lighting systems free of charge.

With these conditions in view, work began on April 18, 1901, and by November 16, 1902, the Company had laid $3\frac{1}{10}$ miles of ten-inch pipe, $1\frac{96}{100}$ of eight-inch pipe, $4\frac{46}{100}$ of six-inch pipe, $8\frac{84}{100}$ of four-inch pipe, $\frac{27}{100}$ of two-inch pipe; or a total of $18\frac{63}{100}$ miles. As will be seen by the above figures, our mains were of ample capacity, nothing less than four-inch being used, except in a very small amount of two-inch pipe which seemed advisable in a few cases. The cast iron pipe was of the standard U. G. I. specifications for cement joints, weighing 610 pounds per length of ten-inch pipe; 492 pounds per length of eight-inch pipe; 365 pounds per length of six-inch pipe; 228 pounds per length of four-inch pipe; only about 1,200 feet of lead joint pipe being used.

During the period of construction the Company engaged the services of an experienced gas engineer and made a house-to-house canvass of the streets along which we were to lay our mains, and a very careful record of house, owner, tenant, whether the house was wired or piped, whether using electricity or not, whether gas was wanted, was obtained, and, by means of a card catalogue, a very valuable and complete report was obtained of each possible customer. The number of houses

visited and the results obtained are shown in the following table:

Town.	Light Used. Elec.	Light Used. Oil.	Wired for Elect.	Piped for Gas.	For Both.	Favorable to Gas.	Contracts Signed.	Total Houses and Stores Visited
Revere	62	627	234	94	42	348	...	689
Beachmont	71	271	121	17	7	286	...	342
Revere Totals	133	898	355	111	49	634	150	1031
Winthrop	408	787	561	115	84	842	185	1195
Grand Totals	541	1685	916	226	133	1476	335	2226

Gas was turned on to the mains November 2, 1901, and after the mains had been carefully blown out and tested, the commercial sale of gas began about November 24 of the same year. At this time we had laid about 400 one and one-fourth-inch services, and had over 100 customers connected ready to use gas.

As stated before, we were obliged to hire Revere citizens when available for the work in Revere and pay them twenty-five cents per hour for their services, while in Winthrop we were free to hire our labor as we pleased. There were three methods of carrying on the work of construction: First, contract; second, percentage basis; third, to do the work ourselves. Each method was open to serious objections, the least objectionable one being the percentage basis, and we finally agreed with two contractors to do the work on this basis, paying them fifteen per cent. on their pay rolls and money expended in maintaining the tools, etc.

The results obtained by this method are shown in the accompanying table. The conditions under which the two contractors worked were identically the same except for the labor performed on the three-inch pipe, in which case the section constructed by B ran so close to the street railroad track that it was necessary to remove the brow and brace the ditch to prevent the tracks from falling in. This, of course, increased the cost over the ordinary.

		10-Inch.	8-Inch.	6-Inch.
Revere	A	.9787	.7685	.6252
"	B	1.004	.9216	.6853

The nature of the soil in the two towns varied greatly. In Revere we were troubled with street cars for a larger part of the distance, while in Winthrop we had none. The soil in Revere was very hard and a large amount of beach stone was

encountered. In Winthrop a major part of the digging was in fine, hard sand, and in only one section, namely, the Ocean Spray, were we troubled with running sand and gravel. In this locality the sand was so lively that at times we were obliged to dig our ditch at least seven feet wide at the top, or else drive sheathing, which at times was preferable.

The minimum depth of cover on top of the pipe was maintained as near to $3\frac{5}{10}$ feet as possible, and the average width of the trench was thirty inches. But few gates were used, and then only to divide the system into sections for fire purposes; where bridges were crossed, gates were placed on either side, only twenty-six gates being installed, nine of which were at bridges.

We were greatly disappointed not to have been able to sell gas during the summer of 1901, but the large amount of work and consequent delays prevented it. In the spring of 1902, however, we were ready for the summer business; and during June, July, August, and September, our output reached as high as 1,782,000 feet of gas; and in January of 1903, although having lost a large number of summer customers during the month of September, our output was nearly 2,000,000 cubic feet for the month.

Services and mains were laid during the season of 1902, and on January 31, 1903, a total of 995 services had been laid, of which 543 were laid in 1902, 202 in Revere and 341 in Winthrop, with 873 meters set, of which 479 were regular and 394 prepay; 687 stoves had been connected, of which the Company had sold 570. During the past winter a large number of heaters and radiators were sold, the exact number of which, however, we were not able to obtain. The total number of miles of main laid up to this date is as follows: 3.10 miles of ten-inch; 1.96 miles of eight-inch; 5.04 miles of six-inch; 13.10 miles of four-inch; .52 miles of two-inch; or a total of 22.74 miles.

Although the sale of gas was commenced in November, 1901, yet we hardly began the sale of same until January, 1902, and it may be of interest to note the monthly output from January, 1902, to January, 1903, showing how the business has increased. But little gas was sold during November and December of 1901, yet I think it well to show here the output

for every month up to and including January, 1903:

November, 1901	136,277
December, 1901	306,366
January, 1902	288,496
February, 1902	288,260
March, 1902	296,702
April, 1902	335,249
May, 1902	503,964
June, 1902	875,926
July, 1902	1,397,459
August, 1902	1,782,011
September, 1902	1,619,706
October, 1902	1,622,678
November, 1902	1,551,722
December, 1902	2,010,061
January, 1903	1,808,981

The cost of laying the pipes, including teaming, labor at the various rates, including fifteen per cent. commission, but not including the cost of yarn and cement, is shown by the following table:

REVERE.

Size.	Wt. Per Length.	Wt. Per Foot.	Cost. Per Ton.	Cost Per Pound.			Cost Per Foot Laid.			
				Pipe.	Teaming.	Total Del'd.	Cost Pipe Ft. Del'd.	Labor 25 c.	Contract 15 per Cent.	Total.
10″	670	55.8	$22	.011	.0005	.0115	.6417	.3776	.0566	1.0923
8″	492	41.0	"	"	"	"	.4715	.3940	.0591	.9246
6″	365	30.4	"	"	"	"	.3496	.3208	.0481	.7185
4″	228	19.0	"	"	"	"	.2185	.2487	.0373	.5045

WINTHROP.

Size.	Wt. Per Length.	Wt. Per Foot.	Cost Per Ton.	Cost Per Pound.			Cost Per Foot Laid.			
				Pipe.	Teaming.	Total Del'd.	Cost Pipe Ft. Del'd.	Labor 15c.	Contract 15 per Cent.	Total.
10″	670	55.8	$22	.011	.0005	.0115	.6417	.2421	.0363	.9201
8″	492	41.0	"	"	"	"	.4715	.1660	.0249	.6624
6″	365	30.4	"	"	"	"	.3496	.1176	.0177	.4849
4″	228	19.0	"	"	"	"	.2185	.1346	.0202	.3733

The Company was fortunate in obtaining its pipe at a price of $22 per net ton f.o.b. cars Revere. The average cost of the teaming was $1 per ton. The question could be justly asked why the cost of laying the pipe seems high, especially the four-inch pipe, for which the labor charge is thirteen and one-half cents per foot. This is due to the fact that the four-inch pipe was laid in cross streets, which were, as a rule, about 600 feet long and would not permit of a full day's work for the gang of men employed. Thus, at least an hour, if not more, was lost each day in shifting from one street to another. This price is also influenced by a delay on the part of the teamsters in not having pipe on hand in sufficient quantities to prevent delays. In many instances where we were able to secure a full day on a street we laid four-inch pipe as low as six cents per linear foot.

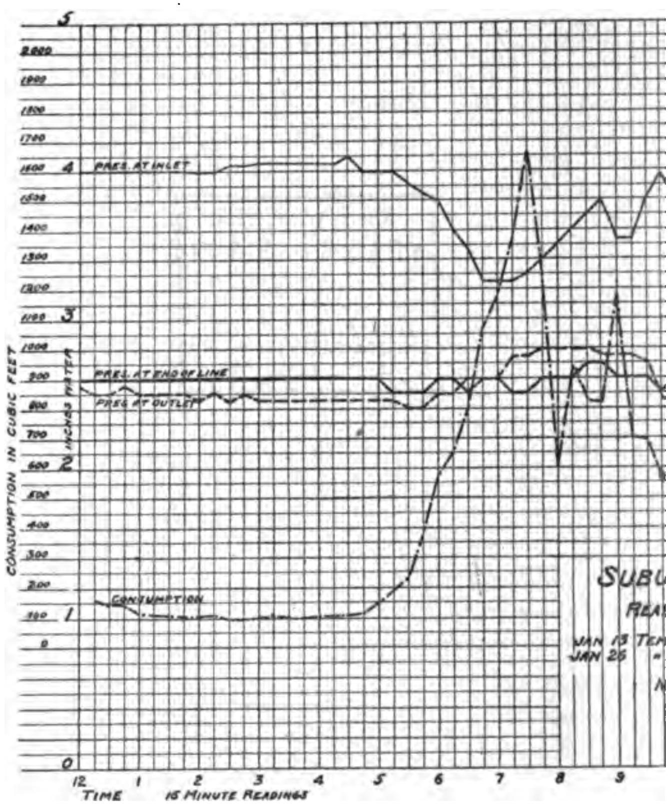
The average length of our services is 47.16 feet, and cost to lay $10.04, or 21.28 cents per foot. The average cost of setting a meter and connecting a stove was $5.38.

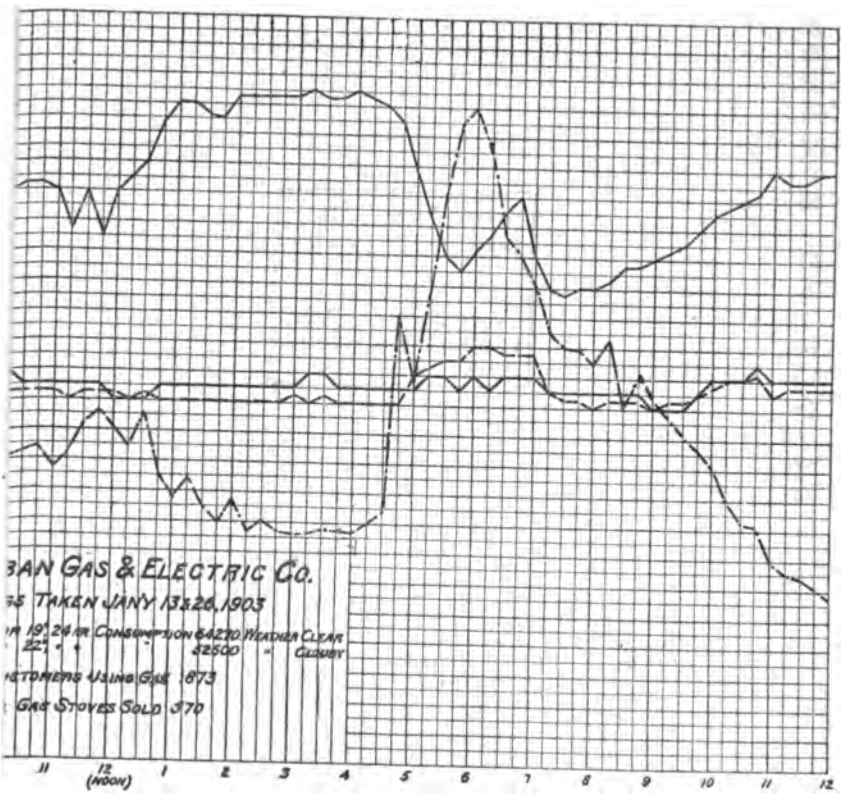
The average cost per mile of main laid was in this case about $4,369.67 per mile, this sum including the building of a piled structure across Belle Isle inlet to carry our main supply pipe.

The following table shows what proportion of the total cost of the plant is represented by the various items which extend into this work.

Tools	0.1	per cent.
Miscellaneous	4.9	"
Pipe	44.04	"
Fittings	.403	"
Labor	34.95	"
Yarn and cement	1.51	"
Teaming	2.75	"
Engineering	3.79	"
Interest	2.92	"

Probably one of the most interesting items in connection with this work is the leakage of the mains. In November, when the sale of gas had commenced, our mains showed a leakage of 480 cubic feet of gas per hour; but by January 1, 1902, this had been reduced to 180 cubic feet of gas per hour. In the summer of 1902, fifteen-minute readings of our station meter, taken between the hours of two and four A.M., showed


PRES. AT INLET
PRES. AT END OF LINE
PRES. AT OUTLET
CONSUMPTION
CONSUMPTION IN CUBIC FEET
INCHES WATER
TIME
15 MINUTE READINGS
SUBU
REA
JAN 13 TEM
JAN 26


BAN GAS & ELECTRIC CO.
GS TAKEN JANY 13&26, 1903
19° 24 HR CONSUMPTION 64270 WEATHER CLEAR
22° 52500 CLOUDY
STOMERS USING GAS 1873
GAS STOVES SOLD 370
11
12 (NOON)
1
2
3
4
5
6
7
8
9
10
11
12

that the leakage or consumption at this time was but 184 cubic feet of gas per hour, or practically the same as in January the same year. This leakage reduced to the basis of a three-inch pipe gives 17,520 cubic feet of gas per annum per mile of main, which seems to be quite reasonable. The leakage obtained by a comparison of our gross receipts for the month as compared with our output is about twenty per cent, but this is readily explained by the fact that we could do double the amount of business with the mains that we have and thus our percentage of leakage would be reduced in proportion.

Two tests have been made to find how the pressure varied with the consumption, and the results of same are shown by the accompanying diagram. The dotted line shows the pressure at the outlet of the governor or the inlet of the mains, and the full line shows the pressure at the end of 5.76 miles of pipe, which is made up as follows: 3.1 miles of ten-inch pipe, 1.16 miles of eight-inch pipe, 1.5 miles of six-inch pipe.

The consumption of gas is shown by the other full line, and it will be interesting to note that two-thirds of the gas is taken in the first one and one-half miles of pipe, which will undoubtedly account for the variations in the pressure at the two ends of the mains. There is also some difference in elevation between the two points, probably ten feet.

During the winter of 1901 and 1902, in order to retain the services of some very efficient men, the Company piped a few houses, and it may be interesting to consider the following table which contains the number of outlets and the actual cost per outlet for doing the work:

	Outlets.	Cost.	Cost per Outlet.
1	11	$19.85	$1.80
2	13	23.36	1.29
3	15	23.09	1.40
4	9	18.35	2.04
5	15	35.12	2.34
6	21	34.40	1.64
7	14	22.12	1.58
8	11	34.78	3.16
	8)109	$211.06	$15.25
	13.6	26.38	1.905

For this work we paid the gasfitter twenty-five cents per hour, and his helper fifteen cents per hour. In soliciting this house piping, we guaranteed the customer that the cost per outlet would not exceed $2.25, providing he would guarantee us at least ten outlets; and if the cost per outlet, based on the rate of fifty cents an hour for fitter and helper, together with the cost of material, plus twenty per cent. on same, should come to less than $2.25 per outlet, we would give the customer the benefit of the same. In a few instances the cost per outlet came to less than $2.25 and the customer received the benefit of it; but the average selling price per outlet, including repairs which we were obliged to make to the customer's ceilings, brought the average price to $2.35; consequently we were obliged to raise our price to $2.50 per outlet, and then we guaranteed our customers perfect satisfaction in every particular. These costs are based on concealed piping.

In connecting lighting systems we experienced considerable trouble on account of the poor work done in piping these houses, and as plumbers were rapidly becoming gasfitters, we were obliged to protect ourselves in some manner, and we decided to subject every lighting system, as far as possible, to a pressure test; consequently our men were equipped with pressure pumps as used by the city of Boston. Owing to the very poor quality of the work which was being done, we made it a rule that the gas piping should maintain a pressure equal to a column of mercury eight inches high for a period of five minutes, and that fixtures should maintain a pressure equal to a column of mercury four inches high for the same period. In this manner we were able to forestall several accidents which certainly would have happened, due to cracked pipe and poor fittings. Of course, this was not pleasing the local fitters, but some idea may be obtained of their ability to do work of this nature from the fact that, in order to find leaks they ingeniously applied a water test to the pipes.

Discussion.

The President—There is a good deal of data in this paper that I hope some of the members will amplify in the case of their own installations. Can any of the members present from Providence give us some information on this subject? Mr. Hutchinson.

Mr. Hutchinson—Never having had anything to do with piping, I cannot give any information on it at all.

The President—The laying of the mains.

Mr. Hutchinson—I never had anything to do with that. It is a separate part of the work.

Mr. Nute—Mr. President, I have not that data at hand. I had not read the paper through to see what was coming up before us. One point, though, struck me in regard to the cost of this house piping. I would say, although we don't do the house piping ourselves at all, that there has been during the past two years probably an average of 1,000 or 1,500 old tenements per year piped in Fall River, the work being done by the gasfitters there. Their charge for this work is $2 an outlet for concealed work, where they have four or more outlets. Where, as they frequently do, they go into a four, five or six tenement house, with five or six outlets to a tenement, they cut that price quite a little. I don't know what the lowest prices are; I think the work has been done at $1.75. This is done at a profit. The profit seems to be sufficiently satisfactory for the fitters to continue the work and to be glad to get it—not only to continue the work but to solicit it. So that, in addition to our solicitors, we have probably eight or ten gas-fitters constantly soliciting work in piping buildings, and probably for the sale of fixtures also. Some of them sell fixtures; some do not.

The President—Is that price on concealed pipe?

Mr. Nute—It is all concealed pipe. They do a very good job. The pipe is all tested by the Company and required to come up to our schedule; that is, the ordinary schedule for the work. Every job is accepted by us before we set a meter.

The President—What is the usual depth of mains in Fall River?

Mr. Nute—Three feet of covering. In regard to the cost of main laying, knowing something of the territory at Winthrop, I should suppose that thirty-seven cents a foot was a pretty high price. Of course I appreciate it is done by contractors at a fifteen per cent. profit. It certainly can be done by the Company for very much less money than that. Although our average cost in Fall River last year was quite a little more than that, it was due to the fact that we ran on to a large

amount of ledge. We generally have more than a fair share, but last year we struck any quantity of it.

The President—Mr. Coffin, will you give us an explanation of the extra cost of pipe laying in ledge? Gloucester is nearly all ledge; isn't it?

Mr. Coffin—We have about one-third ledge in our city. After keeping run of it for about twenty-one years we estimate ledge at $1 per running foot for excavating. It will average about three feet covering; three feet six, three feet eight, ledge. Of course, we strike once in a while something that we call nigger head, where you cannot drive more than two or three inches to drill point, and it won't blow anyhow; there does not seem to be any rift or lift to it. There it will cost more. But our average is practically that. Our pipe laying for twenty years is probably, pipe and all (an average of six-inch pipe) about $1 a foot. That will include digging and all including one-third ledge. We used to pay as high as $4 a yard; and we figured a ditch three feet in length, and it would practically be a cubic yard of ledge, or $1.33 per foot in length. We have got it down now. We have a steam drill; use dynamite instead of black powder, and a battery. Where we used to blow years ago a single hole we cut sixteen-foot oak wood and put in holes closer together, blowing four holes together, using smaller drills. Where we used to drive $1\frac{1}{8}$ steel, which would be $1\frac{3}{8}$ point, we drive $\frac{7}{8}$ steel, which would be about $1\frac{1}{8}$ point. We find we can drive it almost as quick again by the use of hammers. When we use the steam drill we have $1\frac{1}{2}$-inch and larger cartridges. We are not enabled to do that in the city. Outside, where we can blow heavier, we use the steam drill, but in the city we use the $\frac{7}{8}$ drill. If I were going to estimate a line of pipe to be laid to-morrow, I should call it about $1 a foot, pipe and all, and about one-third ledge. That covers the pipe.

Mr. Allyn—I would like to inquire what method Mr. Coffin adopts to prevent the particles of rock flying and causing damage.

Mr. Coffin—We take the wire binders that come around baled hay and use a large quantity of them. For instance, we will cover it over a foot. After it has blown several times, it will mat together so that you can take it all off as one piece.

It acts as a spring, holds all the particles of rock, and saves the concussion on your wood, where you use the latter. Then, if the wood blew up, we use the slivers and soft pieces to pack into the bottom. We find the wood lasts as long again. This goes up as one piece when you blow, and it holds everything. Last year we only broke two lights of glass by the small pieces flying. We used to be able to throw a four-foot stick of wood through a door, but we got over all those things.

Mr. Allyn—We happened to get the idea of using condemned, woven wire mattresses, which certainly are the most effective arrangement we have ever struck. They are glad to have you take them away from the factories when they condemn them. We put them on three or four deep. They prevent almost every particle of rock flying.

The President—Mr. Coffin, how do you fill in the trenches in Gloucester, where they are laid through ledge?

Mr. Coffin—Where there is dirt enough to bed the pipe and cover it about a foot we do that; then we take the finer part of the rock and get something for top dressing. The rest we can usually give away. Sometimes the city will carry it to the crusher; we will load it, and they team it off for the sake of material.

Mr. Africa—The average depth over our mains is three and one-half to four feet. Most of our digging is sand, although we have some ledge. I have a memorandum of the cost of six extensions of a four-inch and six-inch. The shortest one was 116 feet, the longest 1,600 feet, making a total of 3,701 feet of four inch; average cost of labor 13.43 cents per foot; six-inch, 4,032 feet, average cost 13.96 cents per foot for labor alone. I haven't the cost of the material.

The Secretary—Mr. President—I would like to inquire if any members have had any criticisms on the depth of their mains from the insurance people on account of breakages by frost and consequent damage claims, from the fact that their mains were not laid below the frost line.

The President—How many members would lay their mains deeper than they now are laid, for any cause? [One hand was raised.]

The President—Those who are satisfied that their mains are deep enough will kindly raise their hands. [Several hands were raised.]

Mr. Allyn—I would say, Mr. President, that in our city it is not a case of satisfaction, it is a case of finding an opportunity to lay pipe. The original plan was to have the gas mains laid about three feet, and the water main from four to four and one-half, and then the shallow house sewers would come anywhere from one and one-half feet to two or three feet under that and then the deep sewers; but of late years, since the telephone companies have commenced the laying of the electric conduits, the whole equilibrium has been disturbed. They will run along on a given level until they strike some obstruction, when they will dive down, in some cases, seven, eight or nine feet deep, and when they clear the obstruction which they have met they will come up again to the original level. So that it is a difficult matter in some cases to find a way through the streets for our pipes. In Somerville and Cambridge they have in recent years started on the construction of storm sewers, in addition to the regular sewerage system. Then we have the metropolitan water system and the metropolitan sewerage system, so that the streets are becoming so congested with pipes of one kind or another that when we had occasion to lay a twenty-four-inch feed main three years ago we came to one point where we found it impossible to get the main through without diving down I think to a depth of seven feet—in order to cross from a depth of two feet to a depth of nine feet, the street was literally filled with sewers, water pipes and conduits.

Mr. Cathels—Mr. President, regarding the depth of mains in streets, I may say that I came from a town which is considered to have pretty cold weather. Our average depth was three feet six. The city this last three or four years has spent a great deal of money on putting down permanent roadways. The Gas Company before that was done took the precaution to examine all the mains in the streets where this work was contemplated, and we spent a great deal of money in that way. I must say that I felt disappointed in having spent so much money, because really we found our mains in excellent condition. We found very few leaky joints, and the mains altogether were in excellent condition. This was in a town where it is considered very cold, a town in Canada. I am satisfied from that that three feet six is plenty deep enough, as far as the effect frost would have on the mains is concerned.

We found trouble in our services a great deal more than we did in the mains.

The President—I have here a statement of the cost of laying water mains in Providence at an average depth of five feet, in 1901, for sizes from four to thirty-six, with iron at $30, and in 1900 with iron at $35. In comparing the results for large sized mains, twelve and twenty-inch, I find that the prices here agree within one per cent. of what I found was the cost for laying gas mains at a much less depth. Apparently the city employees did pretty good work in this instance. The Providence statement is:

PROVIDENCE, R. I.—CITY ENGINEER OTIS F. CLAPP, ANNUAL REPORT, 1901.

The approximate cost of laying ordinary water pipes, with appurtenances, except hydrants, and including iron at $30 per long ton: For

4-inch	$0.498	per foot.
6 "	0.725	"
8 "	0.973	"
10 "	1.244	"
12 "	1.593	"
16 "	2.403	"
20 "	3.359	"
24 "	4.454	"
30 "	6.348	"
36 "	8.540	"

PROVIDENCE, R. I.—CITY ENGINEER OTIS F. CLAPP, ANNUAL REPORT, 1900.

The approximate cost of laying ordinary water pipes with appurtenances, except hydrants, and including iron at $35 per long ton: For

4-inch	$0.556	per foot.
6 "	0.815	"
8 "	1.098	"
10 "	1.408	"
12 "	1.8009	"
16 "	2.730	"
20 "	3.817	"
24 "	5.052	"
30 "	7.195	"
36 "	9.683	"

Mr. Richardson—I don't think that I have at hand, Mr. President, any figures; but the average, if I remember, in our soils is from twelve and one-half, thirteen, thirteen and one-fourth, varying from three to four feet and six inches. We have abandoned the use of three-inch at the present time. A six-inch pipe would not average much more than thirteen and one-half cents to lay in portions of our soil. Fortunately, there is very little ledge in the center of North Adams. We endeavor to lay the mains, however, deeper than three feet six inches, as many times, in such work as we can do in the winter; we find frost at a depth of five feet. In the New England climate, in my opinion, if we could lay a main six feet deep we would be saved a great deal of trouble. Some winters—it seems to go in cycles—we don't have much trouble, and in others there are a great many broken pipes. This season, the snow coming earlier and before the cold weather, the frost has not gone so deep. We have had but two broken pipes. I have not any especial data in my possession, Mr. President, but it averages about as has been said.

Mr. F. W. Humphreys—I would like to ask Mr. Tenney if he can give us the average length of pipe from meter to stove. He has given the cost of setting the meter and this pipe as $5.04.

Mr. Tenney—I should say off-hand that it would take about thirty-two feet of pipe, roughly speaking. Some of them were less than that, and, of course, some of them took more.

Mr. F. W. Humphreys—Did that include the cost of the meter connection as well?

Mr. Tenney—Yes; that included the meter connections.

[On motion of Mr. Leach, a vote of thanks was tendered to Mr. Tenney for his very interesting paper.]

SOMETHING FROM THE COMMITTEE ON SELLING GAS.

The President—I see the Committee on Selling Gas is leaving the room. Is there any report to make. Perhaps we are selling all the gas we can make.

Mr. C. J. R. Humphreys—I am sorry, Mr. President, that I have to leave. I am afraid the committee has not any report

to make. It has not been able to secure reliable, definite data which it seemed worth while putting in the form of a report. I am sorry we have not been able to do anything more.

The President—A question just handed in may be quickly considered. It is:

> "What gas company in the East has the best arranged office and salesroom for gas appliances?"

I suppose this means that all the members will stand up.

ELECTION OF OFFICERS.

Mr. Fowler—In the absence of the chairman of the Nominating Committee, who has had to leave, I submit the following report: That the present officers all be retained in their positions for another year. This was the result that the committee arrived at after considerable discussion.

On motion of Mr. Coggeshall the report was received and adopted.

On motion of Mr. W. A. Learned, it was determined to proceed with the election of officers. On motion of Mr. C. F. Prichard, Mr. S. J. Fowler was directed to cast the ballot of the Association for the officers as reported by the committee; and Mr. F. C. Sherman was appointed teller. The latter subsequently reported that the result of the ballot was the re-election to office of the gentlemen who served the Association in an executive capacity during the past year.

The President—You have elected the Board of Directors and the officers as they were last year. Speaking for myself, gentlemen, I want to say that I deeply appreciate this honor, and will assure you that I welcome the opportunity to assist the Secretary in the large amount of work that he is going to have on his hands this year. I thank you. [Applause.]

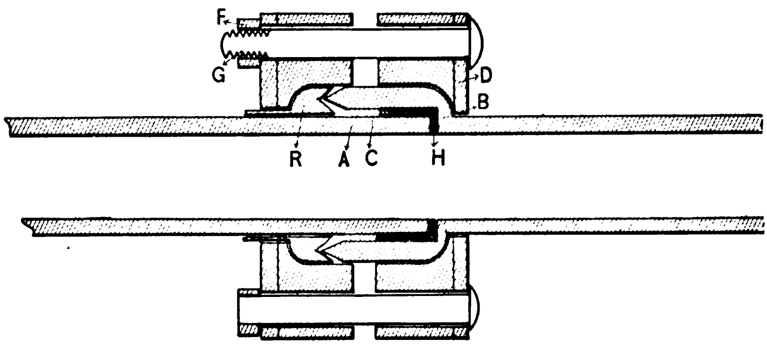
Mr. Richardson—Mr. President and Gentlemen of the Association: I wish to express my appreciation of the compliment implied in my re-election to the office of First Vice-President. If my efforts have been of any avail to assist the other officers, surely it will be a pleasure to continue the same during the present year. I thank you very kindly.

The President—We will now give our attention to the reading of the paper by Mr. W. A. Learned, of Newton, Mass., entitled

Notes on High Pressure Distribution.

Our Company supplies eleven villages with gas, covering about twenty-five square miles of territory, branching out three to six miles from the works. The elevation of the territory varies from eighteen feet above low water to 240 feet. Four of these villages are on about the same level as the works.

The problem to be solved was to increase the pressure in the four villages and fill a holder three and one-half miles away which supplies four other villages beyond. This was accomplished by the installation of a high pressure pipe line, which is 9,600 feet long, using six-inch cast iron pipe with special bell and spigot joints and the necessary compressors

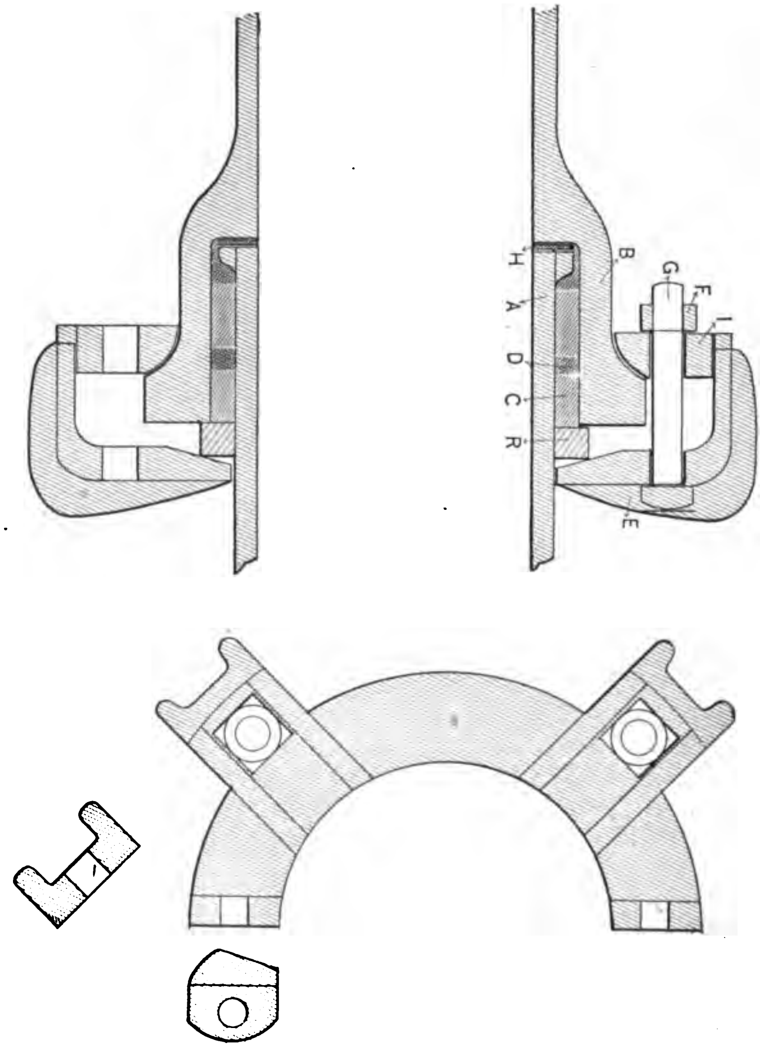


The Dresser Joint.

and condenser. This pipe line under high pressure has the capacity of a twenty-inch pipe line, and serves the purpose of a supplementary supply in case of accident to the main low pressure pipe line. This system was designed to take care of the distribution in the territory for years to come by future extensions.

The six-inch pipe was made of cast iron, by R. D. Wood & Co., with special bell and spigot joints designed by S. R. Dresser, of Bradford, Pa. The Dresser coupling for cast iron pipe requires pipe cast especially for this coupling, having, in place of the regular bell a smaller bell, cast with a bevel edge over which the packing fits, a packing ring of rubber made with a V-shaped recess, and two malleable iron followers or

rings which, when drawn up by bolts, compress the rubber and make an absolutely tight joint. The construction of the



The N. & W. Joint.

coupling is such that the rubber is hermetically sealed from all action of the contents of the line or the surrounding earth.

The principal advantages are: The possibility of an absolutely gas tight line for any pressure; the making of every joint a perfect expansion joint, thus doing away with all breaks due to contraction or the settling of the pipes in the trench; the ease and facility with which pipe may be laid on top of the ground and put into the trench afterward; the saving of expense on trenches, owing to the fact that a very much narrower one can be used than is possible where work must be done after the pipe is lowered; and that, by the use of the insulating style of coupling, the line can be made absolutely proof against all disintegration due to electrolytic action.

The illustrations will assist in the description, which may thus be stated: *A*, spigot; *B*, V-shaped bell of pipe; *C*, cement; *D*, malleable iron ring; *F* and *G*, bolt and nut; *H*, asbestos ring; *R*, rubber ring.

The bends are regular fittings made with cement joints, with the style of clamp marked N and W on the photograph and cross section. The N and W clamp was designed to use on one mile of six-inch pipe that was in the ground, making it a high-pressure line.

Description of the N and W clamp: *A*, spigot; *B*, bell; *C*, cement; *D*, packing; *E*, ring on face of bell; *F* and *G*, nut and bolt; *H*, asbestos ring; *I*, collar back of bell; *R*, rubber ring.

The last 1,000 feet of pipe was laid with common six-inch cast iron pipe, cement joints, with N and W clamps, because of the non-arrival of the special pipe and the lateness of the season. All pipes were tested with forty pounds air pressure. The Dresser pipe was made up on the top of the trench and lowered into position, adopting the practice in use in the oil and natural gas regions. The cement joint pipe was laid in the usual manner in the bottom of the trench. A few hours were allowed for the cement to harden before the clamps were put on. The line was tested every night as the work progressed. The final test of the two days showed an absolutely tight line. The pipes were all laid to a grade from two to three feet below the surface which was above the gas and water services. This was within the frost area, but the dry gas prevents any deposit, the flexible joints preventing any damage to the pipe from the action of frost or when the steam roller

was at work on the top of the trench, even upon the cement joints with clamps. It did not matter how poor the cement joint was made, provided there was a hard surface at the face of the bell for the rubber to press upon. Under the worst condition the clamp joint for cement could stand forty pounds pressure, which is equal to 100 pounds water pressure. The water acts as a cushion filling up the pores of the pipe and material. The pipe line was tapped in the depressions, and a three-fourth-inch pipe brought to the surface to draw off any condensation.

The high pressure line will be in operation from November 1st to March 1st, from sunset to 8 o'clock P.M., taking off the peak of the load in the heaviest season. The balance of the year this pipe line will be used on low pressure service.

The compressors are of the so-called "straight line" type made by the Rand Drill Co.; twelve-inch steam cylinder, sixteen-inch air cylinder and sixteen-inch stroke. The steam cylinder is fitted with a Meyer cut-off, permitting more expansion of the steam in the cylinder than would be possible with an ordinary slide valve. It also permits the horse power developed at the steam end to be changed at will, thus permitting a wide range of pressures on the gas end without seriously interfering with the economy of the steam end.

The gas cylinder is fitted with the new Rand imperial valves, Corliss inlet and vertical poppet outlet, giving a high volumetric efficiency and permitting the cylinders by their position to be more thoroughly water jacketed than is usually possible.

RESULTS OF TESTS ON COMPRESSOR.

Boiler pressure	68 pounds.
Gas pressure	5 "
Indicated horse power, steam end	3.76
" " gas end	3.38
Mechanical efficiency of machine	90 per cent.
Total number feet compressed	31,924
Duration of test	$2\frac{3}{4}$ hours.
Diameter of gas cylinder	16 inches.
" steam cylinder	12 "
Stroke	16 "

At the end of the high pressure line we located a low pressure regulator manufactured by the Chaplin-Fulton Company, Pittsburg, Pa. This was placed in a brick manhole with suitable cover. It regulates from twenty pounds to a few inches. The cross section of governor will give a good idea of its working parts.

RESULTS OF CANDLE POWER DETERMINATIONS.

Holder Gas	5 Lbs.	10 Lbs.	20 Lbs.	30 Lbs.	
16.14-candle power	....	15.73	....	....	Coal gas.
17.59 "	....	18.09	16.05	....	23% water gas.
18.56 "	....	....	15.48	15.02	22% "
17.10 "	17.30	16.15	....	....	29% "
14.8 "	....	13.2	....	....	Coal Gas.

The candle power determinations were made on a bar photometer, set up three feet from the condenser. The temperature of the gas was 62°. The "F" size, new style Sugg's London Argand burner, having been found most suitable for coal, mixed and low candle power gas. The standard English sperm candles, six to a pound, were used as standard.

THESE GAS ANALYSES WERE MADE BY J. F. WING, CHEMIST, THROUGH THE KINDNESS OF W. R. ADDICKS.

	Holder Gas.	Pounds Compression.		Holder Gas.	Pounds Compression.	
		10 lbs.	20 lbs.		20 lbs.	30 lbs.
	D.	C.	A.	E.	F.	B.
CO_2	2.5	2 3	2.4	2.0	2.0	2.1
Illuminants	6.0	6.0	7.0	6.7	6.5	6.7
O_2	0.2	0.0	0 0	0.0	0.0	0.0
CO	12.3	12.3	12.2	12.6	13.3	12.4
H_2	50.6	50.2	47.3	49.2	49.1	46.6
CH_4	26.4	26.7	25.0	28.0	27.1	27.6
N_2	2.1	2.0	5.7	1.5	2.5	4.7
Total........	100.1	99.5	99.6	100.0	100.5	100.1
Candle Power	17.6	18.1	16.06	18.59	15.48	15.02

The increased candle power and brilliancy at five pounds compression can be accounted for by the decrease of the moisture in the gas. Many attempts have been made to dry

the gas with the result, that when it was deprived of its moisture the illuminating power was increased to a considerable extent. By actual tests it was shown that sixty-five per cent. of the moisture in the gas could be taken out at ten pounds compression, and practically all the moisture at twenty pounds. Naphthaline is produced when there is a deposit of aqueous vapor, and gas deprived of aqueous vapor does not deposit naphthaline under ordinary conditions of temperature and pressure. There is no advantage gained to compress at a higher pressure than six pounds to overcome friction and remove moisture from the gas, thereby changing the color of the flame to a white light which is attractive to the public.

We pumped 18,200 feet per hour through six-inch pipe 9,600 feet long, ten pounds initial pressure, 9.28 terminal pressure = .72 pounds loss on line. Two minute pressure observations were taken at the same time for one hour.

Cox's high pressure computer is less than actual results but safe to rely upon.

Prof. S. W. Robinson, of Columbus, O., has kindly forwarded me the following formula, which is slightly in excess of the observed results:

V (cubic feet hour air pressure)—

$$= 48.4 \frac{T^1}{\sqrt{T_2 T_0}} \sqrt{\frac{d^5}{L} (P_1 + P_2 + 30)(P_1 - P_2) \frac{0.6}{\text{sp. gr. gas}}}$$

Where T^1 = absolute temperature of storage = 461° + reading F° scale.

T_2 = absolute temperature flowing gas in pipe line reading F° scale.

T_0 = absolute temperature = 461° + 37° F = 498°.

d = diameter in inches of pipe line.

L = length in miles of pipe line.

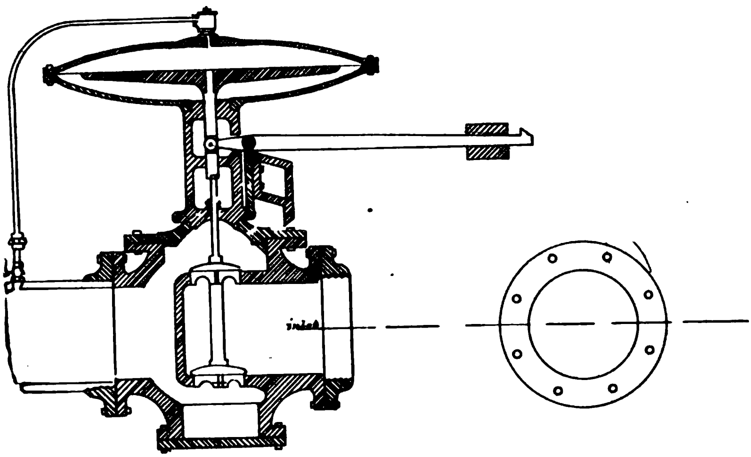
P_2 = apparent pressure at lower end of pipe line where gas is delivered; pounds per square inch.

P_1 = apparent pressure at upper end of pipe line, pounds per square inch.

Discussion.

The President—Gentlemen, here is a paper that is overflowing with fresh material.

Mr. Allyn—I happened to be at Mr. Learned's works when the compressor was being erected, and I noticed that he was erecting in connection with it a condenser, which I understood was to reduce the temperature, which was increased by the action of the compressor. I think it might be interesting if Mr. Learned would give us a few facts respecting how much the temperature does increase, and under what given pressures?

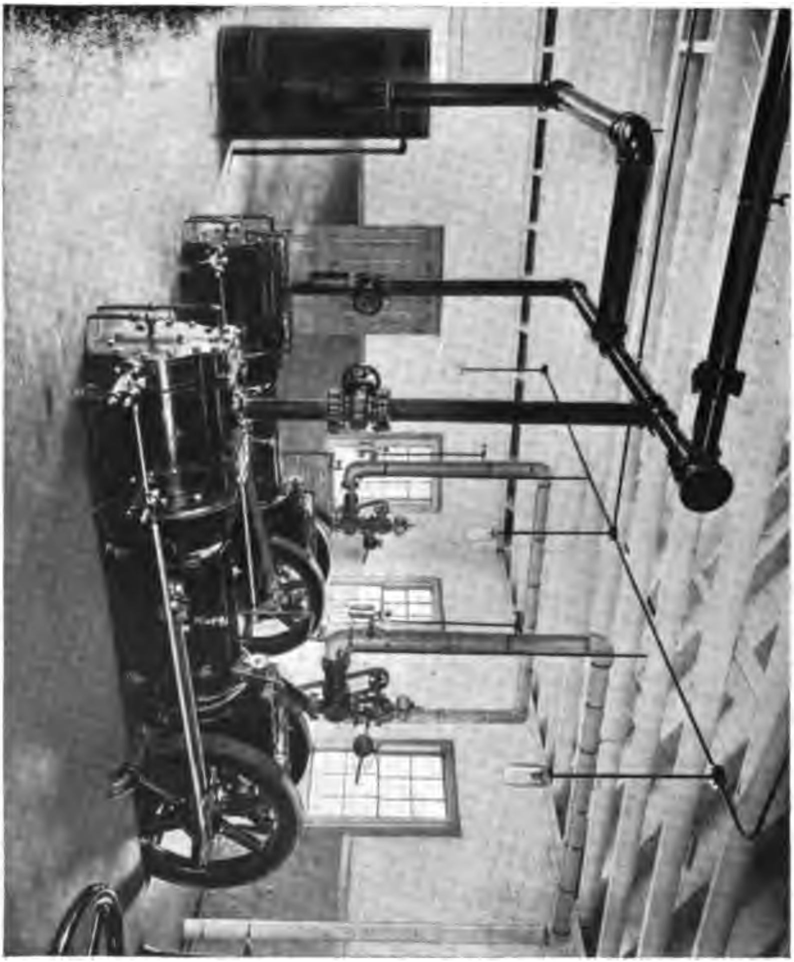


Low Pressure Regulator, manufactured by the Chaplin-Fulton Mfg. Co.

Mr. W. A. Learned—Theoretically, without any water jacketing of the cylinders, at five pounds compression there would be a heat of 106°. At twenty pounds it would be 207°. The cylinders are all jacketed, and the gas passes very quickly into the water condenser, so that at the outlet of the water condenser the gas is about 60°. I have not made any tests on temperature between the machine and the outlet of the condenser.

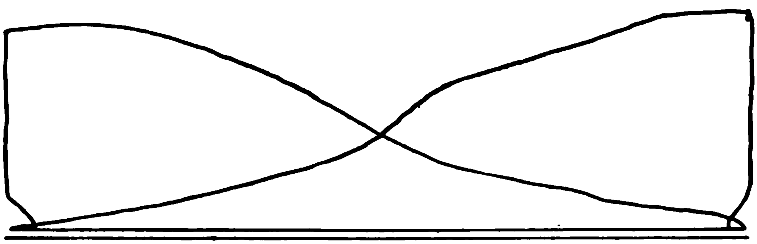
Mr. Allyn—Are there any indications of naphthaline?

Mr. W. A. Learned—None whatever, even in the distillation of the hydrocarbons. In one sample we got simply a slight trace of naphthaline in the distillation tests.

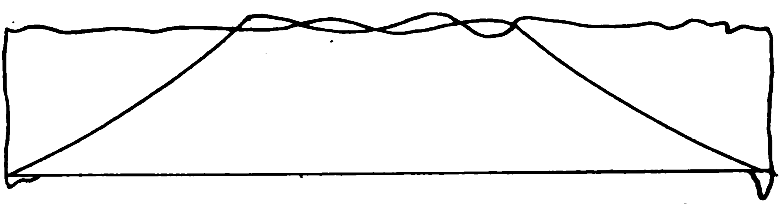


The Compressors.

The President—I tried to get the Danbury (Conn.) Company, which has the original high pressure installation, to send some data with respect to that, but the superintendent, who was unable to come to the meeting, said that the line was not arranged, so that many facts, other than the one that "IT WORKS," could be ascertained. "We pump direct from the holder," he says, "so have no measure of the quantity pumped. Having no photometer in Bethel, we do not know what difference, if any, there is in candle power." Mr. Coffin, what does your line at Schenectady carry?



Steam Card, 12 inches by 16 inches;
Balanced Meyer Valve; Spring, 20 pounds; Cut-off, 44.



Imperial Type, 10; Gas Cylinder, 16 by 16; Guage, 8 pounds;
Spring, 10 pounds.

Mr. Coffin (*Schenectady, N. Y.*)—It varies with their consumption. It goes as high as 4,600 and as low as 200. They use it day and night. On a test in one furnace they used 4,600 feet in twenty minutes.

The President—You delivered 4,600 feet in twenty minutes?

Mr. Coffin—Yes. The compressor is supposed to handle 14,000 feet an hour, which is what they expect to use.

The President—You have just reached the limit of the compressor, then?

Mr. Coffin—We opened up the compressor. Its full limit was 100 pounds more pressure. They opened up a big furnace

at their end of the line and let it go, and we nearly burned down a building before we got word to stop it. We measure the gas at our end of the line through a five-foot station meter on the inlet of the compressor. When we first connected it up we had it connected on the city main on the inlet, and that did not work. We now put it on the outlet of the ten-foot station meter. The ten-foot station meter will fluctuate about .3 of an inch; the five-foot meter fluctuates about .6 or .7 of an inch. That is up as high as we have run it at the present time.

The President—When your main was delivering at the rate of 14,000 feet per hour what observation did you take on fall of pressure at the compressor and the consumption end of the line?

Mr. Coffin—Well, you see we carry thirty-six pounds at our end, and they have fifteen ounces at their end.

The President—Is there a regulator interposed?

Mr. Coffin—At their end of the line, not at ours.

The President—You don't know what the pressure is on the far side of the regulator?

Mr. Coffin—Thirty-five pounds is what the compressor maintains at our end of the line. So far it has maintained that absolutely. At their end of the line it is twenty-five pounds, or ten pounds less.

The President—When it is going at the rate of 14,000 feet an hour from a four-inch pipe?

Mr. Coffin—It seems to stand at that all the time.

Cubic Feet of Gas Compressed.	Compression Pounds.	Water Condensation oz.	Hydrocarbon oz.	Hydrocarbon Per Cent.	Hydrocarbon Beaume.	Hydrocarbon Sp. Gr.	Distillation of Hydrocarbon.							
							232°	246°	271°	282°	309°	318° to 331°	354° to 370°	Residue and Loss
39,000	5	150	41.5	27	26.75°	.894	.....	7.5	19.25	10	15.60	14.13	19.15	14.37
39,800	10	179	11.2	38½	28°	.886	6.5	16.3	17.4	0	16.9	13.9	20.8	8.2
38,200	20	280	19.9	41½	27.75°	.889	12	18	20.9	6	10	11.8	13.2	8.1

The President—Can you give us any information as to the oil condensed out?

Mr. Coffin—Nothing; no data at all.

The President—You have no interest in the candle power anyhow?

Mr. Coffin—No. They wanted the gas at that pressure. We only make one kind and let them have it. That has to suit them. That seems to work. That is all the information I have at the present time. It had only been running for thirty-eight hours when I came away. So far it seems to work, and that is satisfactory to us.

Mr. Richardson—Is that cast or wrought iron pipe?

Mr. Coffin—It is a four-inch, wrought iron pipe. It varies in depth from five feet under the railroads to eighteen inches through the marsh.

Mr. Richardson—And its total length?

Mr. Coffin—Forty-three hundred feet from our end to their controller, and their pipe line is about two miles in their plant. They have about two miles of line in the General Electric Company's distributing system.

Mr. Richardson—On a low pressure?

Mr. Coffin—Yes.

Mr. C. A. Learned—I would like to ask the gentleman how he accounts for a ten-pound drop in pressure on a four-inch line in 4,300 feet.

The President—I think the gentleman stated that the drop took place, no matter what they were sending.

Mr. Coffin—As far as we can get at it, that is the lowest. We have an ordinary steam gauge at our end of the line and an ordinary steam gauge is at their end. We have made no tests.

The President—You have not attempted to gauge it?

Mr. Coffin—No; we have made no tests at all on the line.

The President—If the gauges were shifted it would give a mean.

Mr. Coffin—We have not made any tests of any sort. We know the line is tight. We tried it when we put it in; tried it about four weeks ago, and the pressure stood without any

drop at all for two hours. We know there is no leak in the line. Beyond that we have made no other tests at all. One of the gauges may be off; I cannot say anything about that.

The President—Do Mr. Learned's observations agree with your experience, Mr. Shelton?

Mr. Shelton—Mr. Learned's observations are of the utmost interest to me. I am very glad, indeed, to see that Mr. Learned has broken the ice in New England, and led in a way that I think will be greatly followed when the convenience and the results of distributing at high pressure are more fully realized. I think, too, Mr. Learned should be entitled to that credit; for, to my mind, the Danbury instance is scarcely a parallel case. The Danbury example, which was put in ten or twelve years ago, if I recollect—perhaps more—was a two-inch pipe line, not distributing direct and without holders, and depending only on regulators for accuracy of pressure, but simply to convey the gas, I think, three miles; not to a city, but to a hamlet in which there were 200 or 300 houses—a village, perhaps, is a fair statement—where the gas went into some stationary tanks and was fed out from those tanks into the town.

Mr. Learned, as I understand it, is distributing primarily right from his initial works, using high pressures and no holders, but using controllers for cutting down the pressures at proper points; that is the fullness of the work of the high pressure system, to do away with any holders whatever at the far end. As you know, I have been identified with that work in the last couple of years, thinking it right in the line of increasing our efficiencies and decreasing our investments. The line that about a couple of years ago I put in at Phœnixville, Pa., has worked so smoothly since (and it is now in its third year) that we have almost forgotten its existence. Since that time there are twenty-five or thirty other lines that have been put in. In California there are three or four. There is a line in Jersey, from Camden to Trenton, some thirty-five miles in length, of twelve-inch pipe. Even our electrical friends in Schenectady, N. Y., are commencing to follow this line. So I think it is pretty good evidence that the system is all right, and that while it is not a cure for every evil of distribution, it is a splendid thing for certain conditions in the business.

I was very much interested in following the paper, and agree in nearly everything that Mr. Learned has set forth and

described. There are one or two questions I wish to ask him, and there is one thing upon which I take distinct issue. I am very glad indeed to find the first definite statements of candle power tests on such high pressure compressed gas. So far they have been entirely lacking. We have only been able to say in a general way that the compressing of the gas does not hurt it commercially; that there is not enough loss to be apparent at the other end or to amount to anything. I think that can still be said. It is nevertheless of interest to have some specific figures on the subject. The loss is a little greater than I had anticipated. One or one and one-half candles for but ten or twenty pounds compression is a little heavier than I thought the figures would show. It seems to me, however, that there is no reason to question the accuracy or the integrity of Mr. Learned's figures, of course, and we can only hope to have them supplemented by further tests on those lines, and by further tests on his lines, which will throw more light on it and bring out ultimately the absolute loss that is experienced, by compressing gas up to twenty or thirty pounds pressure, if it is more convenient to push it through a small pipe than on the old lines.

I think it is interesting to note in the analyses table that there is no substantial effect, generally speaking, as far as the constituency of the gas is concerned. It seems to me the analyses after compression do not materially vary from the analyses before compression, to any commercial degree, at any rate. Now as to the pipe to be used. Suppose the city starts to put in one of its metropolitan sewers. Suppose there is a settlement of 100 yards or more in heavy rains in the spring, with parallel ditches open, and that sort of thing. I do not know that one is able adequately to protect a cast iron pipe against such contingencies, although he may mean to and try hard to. I believe that a pipe ought to be *wrought iron*, that can be flattened and twisted and sprung and hung and maltreated in almost every fashion, and yet will not fracture, so that the high pressure gas absolutely has the minimum chance of getting out. I believe that guarding against even that one condition or risk is enough of a question to make the wrought iron pipe preferable.

I think I can say that, out of twenty or twenty-five high pressure pipe lines that are now operating or being built, Mr.

Learned is the only one who has put in cast iron pipe. We differ on politics, we differ in various ways, and I, in a most friendly fashion, differ on this point with Mr. Learned. Most of the high pressure pipes so far have put after the compressing pumps a tank for a triple purpose. First, it absorbs the pulsation of the pump, like an air chamber on a water pump; secondly, it is a drip to condense and catch any liquor which is compressed out; thirdly, it serves as a condenser to cool the gas. These tanks may be merely any old boilers that one may choose to put in the line of the pipe. I gather from Mr. Learned that he has improved on that practice and has put in a water condenser. I would like it very much if he would give the dimensions and capacity of that condenser for record in this discussion, so that the capacity that he has installed may be compared with the volume of gas that he is pumping or expecting to pump. I am especially interested for the reason that, while high pressure work is delightfully successful and serves many of our purposes, saving money and all that, we have yet had a few things to work out, to attend to, to look after, and one of them is a deposition of a drip or moisture out on the line.

In two places where I am working on high pressure we get a good deal of oily water in the first 1,000 yards, perhaps 2,000 or 3,000 feet from the works. Beyond that it is perfectly dry; we never go near the drips. The line may be several miles long, but the first half mile captures every drop, until apparently the gas is partly cool. After it is cool we have no trouble. The gas goes out from the works hot; distinctly hot. The degree of temperature depends entirely upon how much we compress it, how fast we run the pumps, and, of course, how much gas is being handled and at what pressure. We have felt that if we completely cooled the gas at the works down to the ordinary distribution or earth temperature, we would not have a bit of trouble from drip in the first 2,000 or 3,000 feet, or yards, out on the line. I feel that as yet that point has not been worked out. The pumping of the gas is comparatively simple, as is the construction of a proper line.

The use of individual house regulators along the line, the protection against accident, the safety provisions, the regulation at the far end by a district governor for turning into a set of low pressure mains, if you please, have all been, I think, almost

[illegible] pounds, and we can [illegible] pound pressure [illegible] to just that extent. [illegible] pipe do the work of a six-inch pipe, [illegible] ordinary or a few pounds

pressure, there is *every* advantage in operating a twenty or twenty-five pounds pressure instead of a five or six.

The President—Before you sit down, Mr. Shelton, will you tell us about the twelve inch Trenton main? Have you any knowledge of any loss of pressure at all comparable to this that occurred in Schenectady? The distance was thirty-five miles I think you said. Is that a wrought iron main?

Mr. Shelton—I was not connected with that work, Mr. President, and know very little about it. We only, in Philadelphia, got from the other side of the Delaware that the line had finally been laid, under the direction of some one from Pittsburg, I believe. There was no adequate provision made for expansion, in the way of proper joints at proper intervals. Shortly after being laid it pulled apart, and it was then restored, and I believe it is now again in use. It is a twelve-inch main of wrought iron. It runs from Camden to Trenton, and feeds Burlington and Riverton and a number of incidental towns in the thirty-five mile stretch.

The President—Do you know what the initial pressure is?

Mr. Shelton—It is a magnificent undertaking, and the largest high pressure artificial gas pumping plant in this country so far, big enough for two cities thirty-five miles apart, with 70,000 or 80,000 population, with all the population between them that is tributary. I do not know what the initial pressure is. They only started a few weeks ago, and have been in an unsettled preliminary operating state. It is hardly fair to judge of what they may be doing yet. They may have a few troubles in starting off, but it will only be a matter of a few months or a few weeks to strike their gait and have the line, I am certain, work with great satisfaction thereafter.

The President—Does your experience approve of pumping coal gas and water gas and mixed gas with equal satisfaction under high pressure?

Mr. Shelton—I would not hesitate, Mr. President, to pump any kind of gas that I might happen to be making. I have so far only pumped water gas in my own line.

The President—Do you know at what temperature that leaves the compressor? You spoke of its being hot; but how hot?

[illegible]

[illegible] done

[illegible] would

[illegible] the

[illegible] the

[illegible] the

[illegible] a very

[illegible] sufficient

[illegible] from

[illegible] will

[illegible] and see if he failed

work it out too. Under those conditions, and under present conditions I would use a steel pipe, or a wrought pipe, whenever I was able to buy the cheapest.

The Secretary—This question I would like to ask Mr. Shelton. He referred to the Trenton line. My question is as to what pressure was carried on that large line. I think that is the largest line that has been set up, is it not?

Mr. Shelton—I don't recollect, sir. I have never happened to learn, but I imagine it is twenty or thirty pounds. If Mr. Frank Moses happens to be in the room—he was connected with the Trenton Company, although he is not at present—he may possibly know more about it.

Mr. Africa—I would like to ask Mr. Shelton about the difference in the expansion between the iron pipe and the cement. If a long line of pipe be covered with cement, is the expansion so nearly the same that the cement covering would not crack? One of the advantages claimed for wrought iron pipe over that of cast iron, for high pressure mains, is that it is more flexible; that is, it will better stand any settling or heaving of the soil; but if we cover wrought iron pipe with a coating of cement we make it a rigid pipe, so that, if from any cause, the pipe were bent, the cement would crack and we would then have an unprotected pipe. This would be the point at which we would most likely have trouble.

Mr. Shelton—I think Mr. Africa is misinformed. It is my impression that the co-efficient of expansion of cement and iron is almost identical, and that that is a particular reason why they would bond excellently and expand or contract uniformly. I had occasion to look into that in the construction of cement purifiers, when expanded metal was used to bond the cement of the side walls of the boxes. I know that the expanded metal interests make the flat assertion that two great reasons for the success of using expanded metal so extensively in concrete work is: First, the fact of the *adhesion* of the cement to the metal; and, second, the fact that the *co-efficients of expansion are substantially the same.*

The President—Mr. Gould, will you please state the experience with cement and what the co-efficient of expansion is?

Mr. Gould—My experience is that the expansion of cement and-iron are practically the same.

The President—Don't you think it makes a great difference as to whether the cement is thoroughly set or not before you begin to calculate the co-efficient of expansion?

Mr. Gould—I should say, if cement was properly set, it was about the same. The expansion of cement and iron is more uniform than lead and iron, and this is one reason why it makes a better joint than lead in a gas main.

The President—Has any other member any further question to ask Mr. Shelton?

Mr. J. J. Humphreys, Jr.—Will Mr. Shelton or Mr. Moses describe the form of joint that failed at Trenton, and whether it failed at the joint or somewhere else in the line when the expansion strain came on it?

Mr. Shelton—The failure in the Trenton line was merely an incident of starting off. I don't think it is anything against it, any more than that they did not sufficiently protect the valves and fittings by expansion joints, such as the Dresser, which is so suitable and worthy that it is entitled to direct mention in such connection. I feel that if they had put a Dresser joint, for instance, close to each valve or fitting, that they would have been protected from undue strain. As a matter of fact, I am told that a twelve-inch valve pulled apart absolutely; that the pull of the line was such that the flange was pulled off the body of the valve one and one-half or two inches.

Mr. W. A. Learned—In regard to the condensation outside of the works, our first drip is 1,400 feet away. We have been running since December, and day before yesterday we took out fourteen gallons. We tried the rest of the drips along the line and found nothing. The condenser is eleven feet high, three feet diameter of shell, with forty-two three-inch tubes, eight feet long. The gas passes around the tubes.

The President—Isn't there a very precipitous rise directly at the works on this main, which is very favorable to retaining the condensation at the compressor?

Mr. W. A. Learned—Yes; and it acts as a first class condenser. The condenser was made by the Western Gas Works Construction Company, and I told them to figure the sizes, etc., on what their experience had been. I have a feeling that if it was absolutely essential to collect all of the condensation at the works the condenser would have to be larger, but really

that first 1,000 feet of pipe in the ground is a most excellent condenser, and in some cases if you had a long line of pipe dripping back to the works I should not spend very much money on a water condenser. I must confess that this did not cost me very much. You might get along even with an ordinary air condenser or an old boiler. I used cast iron pipe on account of cheapness at that size. I think a three or four-inch wrought iron pipe will take precedence, so far as cheapness is concerned, but would not recommend cast iron for those sizes. There is a great deal of flexibility to those joints, as you will perceive when I tell you that the line was made up on the top of the trench and then lowered. The deflection is about 8° or 9° upon each joint. We are troubled with electrolysis, and put this pipe line in a very trying position. It was for that reason that we adopted cast iron, because of its durability, cheapness and ability to get a perfectly insulated joint, which no doubt we have. The gas is measured from the station meter and also from a small holder. The gas is made into this holder from the works, and that is our only method of measuring it. That is checked up by a counter on the apparatus itself. Speaking about the factors of expansion as between cement and iron, as has been stated they are about equal. It was for that reason that we built a large 700,000-foot holder with a cement bottom and wrought iron sides.

Mr. Richardson—Mr. President, I think no other subject could be more interesting or of more value than this. It certainly could not have been presented in a clearer, more concise or more interesting way. I have been at the works in Newton, and surely the details have been portrayed very clearly, very truthfully. I went first to see it, because we are installing twelve miles of the high pressure in North Adams, six to Williamstown and six to Adams. This is a question that will be bound to interest many people from this time on. This is a very valuable paper, exceedingly so, and it will be a paper that can be read with interest and profit when it is published, even re-read. I want the pleasure of proposing a special vote of thanks to Mr. Learned for this paper, and also to Mr. Shelton for his timely discussion upon that subject. [Seconded by Mr. Africa and adopted.]

Mr. Allyn—Before the discussion is closed I would like to inquire of Col. Richardson whether he is intending to use or

is using wrought or cast iron pipe in his high pressure system?

Mr. Richardson—We are using six miles in two different directions, or twelve miles in all; a three-inch on the line to Williamstown and four-inch on the line to Adams, the smaller place not requiring as large a capacity. They will be taken to the small works in the two places, and turned into the low pressure distribution without use of the holders; it will be simply the use of a governor. We planned to have duplicate compressors with exactly the same connections as shown in the paper of Mr. Learned's, but each compressor with a sufficient capacity to feed both ways through one outlet, a six-inch pipe; the three-inch pipe going one way and the four the other. Both lines are of wrought iron.

The President—I had the pleasure of seeing the main in Newton when the work was being finished, and the conditions are such that I think Mr. Learned will continue to get thoroughly satisfactory service out of it. He has definitely settled in his own mind, I deduce from his paper, that he is going to carry not in excess of five or ten pounds pressure. That is a very important point settled at this stage of his experience. I think that his service will be very satisfactory. The members are invited to visit this afternoon, if they are interested in the matter, the factory of the National Bread Company, of New England, 54 Chardon street, Boston. Two gas heated ovens are there installed, each having a capacity of about 800 loaves of bread per hour. There are also installed two gas engines, direct-connected to electrical generators which furnish all the light and power used in the building. A point of interest in this engine plant is the use of the hot water from the jackets of the engines to heat a room in the building and supply all the hot water consumed in it. The ovens are believed to be the largest as yet built in this country. As the question of gas engines seems to be one of growing interest all the time, I am glad to be able to mention also that the National Meter Company has in operation at its store, 159 Franklin street, a twenty-horse power direct-connected Nash gas engine for lighting purposes, and it will be pleased to show the plant to any members who are interested in the extension of the use of gas for power and lighting in this way.

ACKNOWLEDGING LETTERS OF REGRET.

The Secretary is in receipt of a large number of letters from friends and members of the Association, including Mr. A. S. Miller, President of the American Gas Light Association, Dr. Schniewind, Mr. Snow, who by the way states that he thinks he will be able to contribute a full set of proceedings of the Holyoke Commission to the library, Mr. E. C. Jones, of California, Mr. Alex. C. Humphreys, President of Stevens Institute of Technology, Mr. Pritchett, President of the Massachusetts Institute of Technology, Mr. E. G. Pratt, Mr. W. R. Beal, and a great many others. Is there any other business to come before the meeting?

The Secretary—Mr. President, if you will kindly sit down and allow me to address the First Vice-President and the members of the Association for a moment, I would like to call attention to four very valuable papers which have appeared before this meeting of the Association, three of which have no name attached. One of them you have heard read by the President. Naturally you can guess at its authorship. The list of members, which you have all had copies of, was also prepared by the President. The list of papers which have been read before this Association during its entire existence, arranged both chronologically and by topics, has also been prepared by your President. The other publication, in regard to the library fund, comes from the same source. I merely mention that as an instance of the persistent industry which you all know belongs to this gentleman, and to call your attention to this exhibition. It would be useless for me to enlarge further upon his services to the Association. I personally am glad, as you have done me the honor to continue me in this position for another year, that you have allowed me to be associated with Mr. McKay for another year, of course, having the further delight to look forward to be associated with the other gentlemen in years to come.

Mr. Fowler—Mr. First Vice-President, we wish very much to express our thanks to our present President and to the Secretary for the efficient manner in which they have performed the work of the year and conducted the business of the present meeting.

The President—Gentlemen, it is very pleasant to have this statement made, however incomplete the veracity may be. The Secretary has been as modest in avoiding mention of his own work as he has been generous in speaking of the work of others. Is there any other business? If not, a motion to adjourn will be in order.

On motion of Mr. Allyn the meeting was declared adjourned.

OFFICERS

OF THE

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

MARCH 1, 1903.

President:

WILLIAM E. McKAY.

Vice Presidents:

F. S. RICHARDSON, WILLIAM McGREGOR.

Secretary and Treasurer:

N. W. GIFFORD.

Office, East Boston, Mass.

Directors:

W. G. AFRICA, JOS. E. NUTE, WM. H. SNOW,

BENJ. J ALLEN, T. H. HINTZE.

1871–1884
1884–1892
1892–1899
1899 ——

MEMBERS

OF THE

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

MARCH 1, 1903.

Honorary Members.

*JOSEPH R. THOMAS, Gas Engineer and Editor of American Gas Light Journal, New York, N. Y.

GEN. ANDREW HICKENLOOPER, formerly President Cincinnati Gas and Electric Co., 838 Dayton St., Cincinnati, O.

EMERSON MCMILLEN.

COL. FREDERICK S. BENSON.

*EUGENE VANDERPOOL, Newark, N. J.

*WILLIAM W. GREENOUGH, Ex-Treasurer and Engineer Boston Gas Light Co., Boston, Mass.

CAPT. WILLIAM HENRY WHITE, Constructing Gas Engineer, 62 Wall St., New York, N. Y.

*GEORGE D. CABOT, Director Lawrence Gas Co., Lawrence, Mass.

COL. JAMES H. ARMINGTON, Consulting Engineer, 3226 Pawtucket Ave., East Providence, R. I.

AUSTIN C. WOOD, (Retired) 216 North West St., Syracuse, N. Y.

THOMAS F. ROWLAND, President Continental Iron Works, Brooklyn, N. Y.

WILLIAM A. STEDMAN, Vice President and General Manager Flatbush Gas Light Co., Brooklyn, N. Y.

A. B. SLATER, (Retired) 251 Rhodes St., Providence, R. I.

*Deceased.

Active Members.

Addicks, Walter R., Vice President Consolidated Gas Co., 4 Irving Place, New York, N. Y.

Africa, Walter G., Treasurer and Superintendent People's Gas Light Co., Manchester, N. H.

Alden, George A., Assistant Superintendent Newton and Watertown Gas Light Co., Watertown, Mass.

Allen, Benjamin J., Superintendent Brookline Gas Light Co., Allston, Mass.

Allyn, Horace A., Superintendent Cambridge Gas Light Co., East Cambridge, Mass.

Armory, Dr. Robert, 279 Beacon St., Boston, Mass.

Anderson, William, Lynn, Mass.

Anthony, A. C., Foreman of Construction, Providence Gas Co., Providence, R. I.

Barnes, W. M., General Superintendent Bristol Co. Gas and Electric Co., care Narrangansett Electric Co, Providence, R. I.

Barnum, D. D., Superintendent Worcester Gas Light Co., Worcester, Mass.

Bartlett, Lewis, Superintendent Cottage City Gas and Electric Co., Cottage City, Mass.

Bill, B. P. Superintendent Capital City Gas Co., Montpelier, Vt.

Bradley, William H., Chief Engineer Consolidated Gas Co. of New York, 4 Irving Place, New York, N. Y.

Brockingham, F. T., Superintendent Leominster Gas Light Co., Leominster, Mass.

Brown, J. S., Superintendent Clinton Gas Light Co., Clinton, Mass.

Burritt, D. T., Superintendent Rockingham Co. Light and Power Co., Portsmouth, N. H.

Bush, Robert Wilder, Engineer Metropolitan Works, Brooklyn Union Gas Co., Twelfth St. and Gowanus Canal, Brooklyn, N. Y.

Cabot, John, 1412 Adams St., Hoboken, N. J.

Cathels, Edmund, Engineer Providence Gas Co., Providence, R. I.

Clark, Walton, General Superintendent The United Gas Improvement Co., Philadelphia, Pa.

Coffin, John A., Superintendent and Agent Gloucester Gas Light Co., Gloucester, Mass.

Coffin, Isaiah E., 139 Oxford St., Providence, R. I.

Coggeshall, H. F., Treasurer and General Manager Fitchburg Gas and Electric Light Co., Fitchburg, Mass.

Cook, Ralph W., Providence, R. I.

Cooper, Arthur F., Superintendent Exeter Gas Light Co., Exeter, N. H.

Corson, F. H., Superintendent Winnepesaukee Gas and Electric Co., Laconia, N. H.

Cowperthwaite, George E., Secretary and Superintendent Danbury and Bethel Gas Light Co., Danbury, Conn.

Coyle, Patrick, Superintendent Charlestown Gas and Electric Co., Charlestown, Mass.

Crafts, Harry C., Superintendent Northampton Gas Light Co., Northampton, Mass.

Crawford, R., Superintendent The Gas and Electric Co., Stamford, Conn.

Darbee, William, General Superintendent Conn. Railway and Lighting Co., Bridgeport, Conn.

Dickens, James, Newburyport, Mass.

Dickerson, Arthur T., Superintendent Rockville Gas Light Co., Rockville, Conn.

Dole, E. C., Bangor, Me.

Earle, Alfred G., Superintendent Bristol Co. Gas and Electric Co., Bristol, R. I.

Eccles, Arthur D., Superintendent Ware Gas Light Co., Ware, Mass.

Ellis, J. W., President and General Manager Providence Gas Co., Providence, R. I.

Erhard, Theodore, Assistant Superintendent Cambridge Gas Light Co., 354 Third St., East Cambridge, Mass.

Farnum, George W., Consulting Superintendent Lowell Gas Co., Lowell, Mass.

Fairbanks, F. P., Assistant Superintendent Holyoke Gas Co., Holyoke, Mass.

Fish, Ralph H., Superintendent Taunton Gas Co., Taunton, Mass.

Fowler, Samuel J., Treasurer and Agent Charlestown Gas and Electric Co., Charlestown, Mass.

Frost, Charles T., Superintendent Plymouth Gas Light Co., Plymouth, Mass.

Gerould, C. L., Manager Galesburg Gas and Electric Light Co., Galesburg, Ill.

Gifford, Charles Humphrey, Superintendent N. B. Gas and Edison Light Co., New Bedford, Mass.

Gifford, N. W., General Manager East Boston Gas Co., East Boston, Mass.

Gillette, Sanford E., Engineer Marblehead and Danvers Gas Companies, Danvers, Mass.

Gould, J. A., Chief Engineer, 100 Boylston St., Boston, Mass.

Goulding, Norman O., Superintendent Natick Gas Light Co., Natick, Mass.

Graf, Carl H., General Superintendent J. T. Lynn Co., 208 Fifth Ave., New York, N. Y.

Greenough, Malcolm S., Vice President and General Manager Cleveland Gas Light and Coke Co., Cleveland, O.

Hanford, L. C., Superintendent Norwalk Gas Light Co., Norwalk, Conn.

Harbison, John P., President, Treasurer and General Manager, Hartford City Gas Co., Hartford, Conn.

Hassett, Edward J., Superintendent Beverly Gas and Electric Co., Beverly, Mass.

Hawken, Thomas, Manager Knox Gas and Electric Co., Rockland, Me.

Hintze, Thomas H., Superintendent Lowell Gas Light Co., Lowell, Mass.

Humphreys, C. J. R., Agent Lawrence Gas Co., Drawer K., Lawrence, Mass.

Humphreys, J. J. Jr., General Manager Brooklyn Borough Gas Co., Coney Island, N. Y.

Humphreys, A. C., 31 Nassau St., New York, N. Y.

Jenks, Z. M., Superintendent Woonsocket Gas Co., Woonsocket, R. I.

Jennings, Frank W., Superintendent Framingham Gas, Fuel and Power Co., South Framingham, Mass.

Jones, Edward C., Chief Engineer Gas Department California Gas and Electric Co., San Francisco, Cal.

Kelly, H. H., Waltham, Mass.

Lamson, Charles D., President and General Manager Worcester Gas Light Company, Worcester, Mass.

Lane, H. M., Leominster, Mass.

Lawrence, W. F., Superintendent Ravenswood Works New Amsterdam Gas Co., Ravenswood, Long Island City, N. Y.

Lawson, William H., Superintendent People's Gas Light Co., Rutland, Vt.

*Leach, Henry B., Secretary and Treasurer Taunton Gas Light Co., Taunton, Mass.

Learned, Everrett C., 118 Maple St., New Britain, Conn.

Learned, Waldo A., General Superintendent Newton and Watertown Gas Light Co., Newton, Mass.

Learned, Charles A., Superintendent Meriden Gas and Electric Co., Meriden, Conn.

Leland, George B., Superintendent Norwich Gas and Electric Co., Norwich, Conn.

Leonard, Charles F., Assistant Superintendent Fall River Gas Works Co., Fall River, Mass.

Lomax, Clarence, Assistant Superintendent and Chemist N. E. Gas and Coke Co., Everett, Mass.

Long, Robert J., Superintendent West Point Gas Light Co., West Point, N. Y.

Lucey, F. J., Manager Natick Gas Co., Natick, Mass.

*Deceased.

Mace, F. W., Assistant Superintendent Lynn Gas and Electric Co., Lynn, Mass.

Macomber, George E., Manager and Treasurer Knox Gas and Electric Co., Augusta, Me.

Macmunn, George F., Superintendent Gas Works, Schenectady, N. Y.

Manchester, George L., Treasurer and Superintendent Easthampton Gas Co., Easthampton, Mass.

Mansfield, George W., Superintendent Salem Gas Light Co., Salem, Mass.

McGregor, William, Superintendent Pawtucket Gas Co., Pawtucket, R. I.

McKay, William E., Engineer in Charge Calf Pasture Station, Bay State Gas Co., Boston, Mass.

McKnight, George, Superintendent Athol Gas and Electric Co., Athol, Mass.

Miles, Charles H., Manager Lexington Gas and Electric Co., Lexington, Mass.

Miller, Carroll, M. E., Consulting Engineer, 155 Michigan Ave., Chicago, Ill.

Milne, John D., Superintendent Gas Department Connecticut Light and Power Co., Norwalk, Conn.

Monks, R. J., Agent and Treasurer Woburn Gas Light Co., 35 Congress St., Boston, Mass.

Mooney, E. B., Superintendent Brockton Gas Light Co., Brockton, Mass.

Moore, David, Salem, Mass.

Morrison, H. K., Superintendent Concord Light and Power Co., Concord, N. H.

Morse, Charles W., President Citizens of Quincy, and Amesbury and Salisbury, General Manager Marlboro and Hudson Companies, Haverhill, Mass.

Moynahan, J. F., Superintendent Arlington Gas Co., Arlington, Mass.

Nettleton, Charles H., President Derby and New Haven Gas Companies, Derby, Conn.

Norton, H. A., Manager Tufts Meter Co., 8 Medford St., Boston, Mass.

Norton, Walter F., Superintendent Nashua Light, Heat and Power Co, Nashua, N. H.

Norton, P. T., Assistant Superintendent Nashua Light, Heat and Power Co., Nashua, N. H.

Nute, Joseph E., Manager Fall River Gas Works Co., Fall River, Mass.

Nutting, Charles H., Superintendent Chicopee Gas Light Co., Chicopee, Mass.

Nutter, E. J., Assistant Superintendent Milford Gas Co., Milford, Mass.

Nutter, J. J., Superintendent Milford Gas Co., Milford, Mass.

Parker, F. H., Treasurer and Superintendent Burlington Gas Light Co., Burlington, Vt.

Prichard, C. F., General Manager Lynn Gas and Electric Co., Lynn, Mass.

Purinton, A. J., General Manager Central Mass. Electric Co. and General Manager and Treasurer Palmer and Manson Street Railway Co., Palmer, Mass.

Philbrick, J. E., Assistant Superintendent Brockton Gas Co., Brockton, Mass.

Polk, Roger W., Superintendent People's Gas Light Co., Rutland, Vt.

Quinn, Andrew K., Treasurer and Superintendent Newport Gas Light Co., Newport, R. I.

Richardson, Frank S., Vice President, Treasurer and Manager North Adams Gas Light Co., Adams Gas Light Co., and Williamstown Gas Co., North Adams, Mass.

Rossman, George M., Treasurer and Superintendent Keene Gas Light Co., Keene, N. H.

Sargent, Fred. S., Assistant Agent Lawrence Gas Co., Lawrence, Mass.

Shaw, Herbert S., Treasurer and Superintendent Webster Electric Co., Operating Gas Works, Webster, Mass.

Shelton, Frederick H., 15th and Chestnut Sts., Philadelphia, Pa.

Sherman, F. C. Consulting Engineer New Haven Gas Light Co., P. O. Box 107, New Haven, Conn.

Sherman, Charles D., New Haven, Conn.

Slater, A. B. Jr., Gas Engineer, Fort Wayne, Ind.

Snow, William H., Manager Gas and Electric Department, City of Holyoke, Holyoke, Mass.

Spaulding, Charles F., Superintendent Waltham Gas Light Co., Waltham, Mass.

Spaulding, Charles S., Superintendent Newburyport Gas and Electric Co., Newburyport, Mass.

Spear, John Q. A., 76 Minot St., Dorchester, Mass.

Spear, James N., Superintendent South Boston Gas Light Co., South Boston, Mass.

Stearns, Walter M., Assistant Superintendent Waltham Gas Light Co., Waltham, Mass.

Stevens, C. S., Assistant Superintendent Haverhill Gas Light Co., Haverhill, Mass.

Stone, Arthur F., Superintendent Chelsea Gas Light Co, Chelsea, Mass.

Stratton, W. L., Superintendent Haverhill Gas Light Co., Haverhill, Mass.

Tait, F. M., General Manager New London Gas and Electric Co., New London, Conn.

Taber, Robert B., Burlington, Vt.

Tarbell, A. W., 165 Summer St., Waltham, Mass.

Tenney, A. B., Treasurer Suburban Gas and Electric Co., 111 Tremont Ave., Revere, Mass.

Terry, F. L., New Britain, Conn.

Thayer, William F., Westfield, Mass.

Thompson, C. F., Treasurer and Manager Gas Light Co., Brattleboro, Vt.

Tilton, D. D., Treasurer and General Manager Newburyport Gas and Electric Co., Newburyport, Mass.

Todd, John R., Foreman Lynn Gas and Electric Co., Lynn, Mass.

Travis, F. M., Treasurer New Haven Gas Light Co., New Haven, Conn.

Walker, E. M., Superintendent Dedham and Hyde Park Gas and Electric Co., Dedham, Mass.

Walker, William L., Superintendent Gas Works, Fitchburg, Mass.

Waters, John A., Assistant Superintendent Stamford Gas and Electric Co., Stamford, Conn.

White, Charles E., Manager Municipal Light Plant, Wakefield, Mass.

Wing, Dr. John F., Superintendent Boston Gas Light Co., Commercial Point, Dorchester, Mass.

Willard, Albert R., Superintendent Greenfield Gas Light Co., Greenfield, Mass.

Williams, E. H., Superintendent Waterbury Gas Co., Waterbury, Conn.

Wood, William A., Chief Engineer Boston Gas Light Co., Boston, Mass.

Woodward, Ralph, General Manager Pittsfield Coal Gas Co., Pittsfield, Mass.

Yorke, E. H., Engineer Portland Gas Light Co., Portland, Me.

Young, A. M., 100 Broadway, New York, N. Y.

Associate Members.

Addicks, F. P., 52 Broadway, New York, N. Y.

Allen, Walter S., New Bedford, Mass.

Austin, Calvin, Treasurer and Manager Citizen Gas Light Co. of Quincy, 368 Atlantic Avenue, Boston, Mass.

Baker, Sidney E., Chief Clerk Fall River Gas Works Co., Fall River, Mass.

Barnes, A. M., Treasurer Cambridge Gas Light Co., Cambridge, Mass.

Barnes, F. G. P., Assistant to Treasurer New Haven Gas Light Co., New Haven, Conn.

Baldwin, Charles H., Manager National Meter Co., 159 Franklin St., Boston, Mass.

Brown, George P., Fall River, Mass.

Browne, A. P., Boston, Mass.

Brown, H. F., Superintendent Davis & Farnum Manufacturing Co., Waltham, Mass.

Burrage, A. C., 83 Ames Building, Boston, Mass.

Campbell, W. F., Salesman Perrin & Seaman, Boston, Mass.

Chaney, F. V., Publisher of Gas Literature, 28 Oliver St., Boston, Mass.

Chandler, Frank C., President and General Manager Malden and Melrose Gas Light Co., Chamber Commerce Building, Boston, Mass.

Cheney, Herbert N., Draftsman Bay State Gas Co., 23 Gardner St., Allston, Mass.

Cheney, Charles H., General Manager Gas Works, Cheney Bros, So. Manchester, Conn.

Chisholm, C. F., Assistant Superintendent Suburban Gas and Electric Co., Revere, Mass.

Coburn, Cyrus M., Liberty Oil Co., Chelsea, Mass.

Cortis, D. T., Gas Appliance Exchange, 22 West St., Boston, Mass.

Dart, Edward M., Manufacturer of Gas Cocks, 136 Clifford St., Providence, R. I.

Davidson, Rolland, Newburgh, N. Y.

Davis, Frederick J., Davis & Farnum Manufacturing Co., Waltham, Mass.

Dickel, William L., N. E. Agent H. Mueller Manufacturing Co., Young's Hotel, Boston, Mass.

Dowst, F. B., General Superintendent B. F. Sturtevant Co., Jamaica Plain, Mass.

Dunbar, Albert S., Superintendent Dist. Dept. Brookline and Brighton Div. Brookline Gas Co.

Farrington, Alfred N., Superintendent St. Department Boston Gas Light Co., 24 West St., Boston, Mass.

Finn, George H., General Manager N. E. Gas and Coke Co, 95 Milk St., Boston, Mass.

Fiske, John T., Salesman Schneider & Trenkampf Co., Concord, N. H.

Frazer, E. B., Treasurer Lynn Gas and Electric Co., Lynn, Mass.

Gardiner, William H. Jr., Consulting Engineer, 12 Pearl St., Boston, Mass.

Greims, A. F., 95 Milk St., Boston, Mass.

Griswold, C. S., Foreman Meriden Gas Co., Meriden, Conn.

Hall, A. S., Foreman East Boston Gas Works, East Boston, Mass.

Hamlin, Herman R., Assistant Superintendent St. Department Boston Gas Light Co., 24 West St., Boston, Mass.

Hinman, Charles W., 53 Front St., Charlestown, Mass.

Holmes, Rufus E , President Winsted Gas Co., Winsted, Conn.

Huestis, Frank C., Meter Inspector Cambridge Gas Light Co., 367 Somerville Ave., Somerville, Mass.

Humphreys, F. W., Department Manager New Haven Gas Light Co., 38 Howe St., New Haven, Conn.

Kerr, J. B., Foreman Dist. Department Dedham and Hyde Park Gas and Electric Co., Dedham, Mass.

Macmun, George F. Jr.

Magee, John, Magee Furnace Co., Chelsea, Mass.

Mason, Vinton, Cambridge, Mass.

McKenney, William A., McKenney & Waterbury Co., Boston, Mass.

Meinshausen, Henry, 1111 Norwood St., Chicago, Ill.

Merritt, Charles H., President Danbury and Bethel Gas and Electric Co., Danbury, Conn.

Montgomery, J. K., Chelsea, Mass.

Motley, George S., President and General Manager Lowell Gas Light Co., Lowell, Mass.

Nichols, William B., Superintendent Dist. Department Roxbury Gas Light Co., 2 Kensington Park, Roxbury, Mass.

Norton, A. E., N. Tufts Meter Co., Boston, Mass.

Piser, Theodore H., Manager Welsbach Co., N. E. Department, 68 Franklin St., Boston, Mass.

Plunkett, William R., Treasurer Pittsfield Coal Gas Co., Pittsfield, Mass.

Pratt, Frank S., Equitable Building, Boston, Mass.

Ruggles, Charles S. J., Superintendent Gas Fuel and Light Co., Gardner, Mass.

Russell, D. D., Jas. Russell Boiler Works Co., South Boston, Mass.

Scranton, George H., Secretary Derby Gas Co., Derby, Conn.

Sprague, Phineas W., 70 Kilby St., Boston, Mass.

Stafford, W. R., Salesman Abendroth Bros., 32 Richardson St., Newton, Mass.

Starkweather, R. M., Assistant Treasurer Northampton Gas Light Co., Northampton, Mass.

Thomas, F. W., Salesman Waldo Bros., 102 Milk St., Boston, Mass.

Tobey, Franklin Jr., General Manager Kingston Electric Co., Kingston, N. Y.

Tudor, Frederic J., Treasurer Mass. Pipe Line Co., 95 Milk St., Boston, Mass.

Tucker, C. A., Chief Clerk New Haven Gas Light Co., New Haven, Conn.

Tufts, Joseph P., N. Tufts Meter Co., Boston, Mass.

Waldo, Charles S., 102 Milk St., Boston, Mass.

Waldo, J. Adan, 102 Milk St., Boston, Mass.

Wardwell, William R., Sales Agent Hanson & Parker Limited, 125 Milk St., Boston, Mass.

White, H. E., Superintendent St. Department New Haven Gas Light Co., New Haven, Conn.

Wilder, Charles C., Salesman J. H. Cunningham & Co., 129 State St., Springfield, Mass.

Honorary Members, ...	9
Active Members, ...	144
Associate Members, ...	68
Total, ...	221

List of Founders, 2 February, 1871.

Andrews, J.
Armington, J. H.
Brooks, W. B.
Coggeshall, H. F.
Cushing, O. E.
Dwight, G.
Greenough, W. W.
Jones, Edward.
Mace, A.
Moore, D.
Neal, G. B.
Norton, A. M.
Sherman, F. C.
Stedman, W. A.
Stiness, S. G.
Warren, G. F.

Elected at same meeting.

Cabot, G. D.
Durfee, W. B.
Gerould, L. C.
Giles, A. M.
Hill, J. M.
Howe, E.
Pishon, F. J.
Taber, W. C.
Yorke, W.

List of Members, Dec. 1902, arranged by date of Election.

1871.

Stedman, W. A.	honorary.	Greenough, M. S.	active.
Coggeshall, H. F.	active.	Harbison, J. P.	"
Gerdinier, C. A.	"	Moore, D.	"

1872.

Learned, E. C., active.

1873.

Allyn, H. A.	active.	Hanford, L, C.	active.

Lamson, C. D., active.

1874.

Nettleton, C. H.	active.	Slater, A. B.	active.

Spaulding, C. F., active.

1875.

Manchester, G. L.	active.	Tilton, D. D.	active.

1876.

Bradley, W. H.	active.	Monks, R. J.	active.

Stratton, W. L., active.

1878.

Frost, C. T.	active.	Tarbell, A. W.	active.

Todd, J. R., active.

1879.

Spear, J. Q. A., active.

1880.

Yorke, E. H., active.

1881.

Cabot, J.	active.	Snow, W. H.	active.
Jones, E. C.	"	Spaulding, C. S.	"
Prichard, C. F.	"	Taber, R. B.	"

1882.

Coyle, P., active.

1883.

Coffin, J. A.	active.	Hallett, J. L.	active.
Davis, F. R.	"	Leach, H. B.	"
Gerould, C. L.	"	Learned, W. A.	"

1884.

Jenks, Z. M.	active.	Richardson, F. S.	active.

1885.

Cooper, A. F.	active.	Norton, H. A.	active.
Humphreys, C. J. R.	"	Wood, W. A.	"

1886.

Parker, F. H., active.

1887.

Hickenlooper, A.	honorary.	Anderson, W.	active.
McMillen, E.	"	Hassett, E. J.	"

Long, R. J., active.

1888.

Africa, W. G.	active.	Manchester, J. H.	active.
Fairbanks, F. P.	"	Quinn, A. K.	"

Woodward, R., active.

1889.

Benson, F. S.	honorary.	Slater, A. B., Jr.	active.
Vanderpool, E.	"	Coburn, C. M.	assoc.
Addicks, W. R.	active.	Davis, F. J.	"
Amory, R.	"	Gifford, N. W.	"
Coffin, I. E.	"	Holmes, R. E.	"
Fowler, S. J.	"	Tobey, F., Jr.	"
Kelley, H. H.	"	Waldo, C. S.	"
Macmun, G. F.	"	Waldo, J. A.	"

1890.

Anthony, A. C.	active.	Nutter, E. J.	active.
Lane, H. M.	"	Nutter, J. J.	"
McKay, W. E.	"	Rossman, G. M.	"
Norton, W. F.	"	Spaulding, W. H.	"

Brown, F. H., assoc.

1891.

White, W. H.	honorary.	Cortis, D. L.	assoc.
Gifford, N. W.	active.	Merritt, C. H.	"
Jennings, F. W.	"	Sprague, P. W.	"

Thomas, F. W., assoc.

1892.

Armington, J. H.	honorary.	Hayden, W. H.	active.
Bush, R. W.	active.	Humphreys, A. C.	"
Gerdinier, C. M.	"	Williard, A. T.	"

Mace, F. W., assoc.

1893.

Bartlett, L.	active.	Addicks, F. P.	assoc.
Hintze, T. H.	"	Allen, W. S.	"
Nute, J. E.	"	Browne, A. P.	"
Sherman, C. D.	"	Dart, E. M.	"

Tufts, J. P., assoc.

1894.

Mooney, E. B.	active.	Mason, V. W.	assoc.
Purinton, A. J.	"	McKenny, W. A.	"
Hinman, C. W.	assoc.	Pratt, F. S.	"

1895.

Rowland, T. F.	honorary.	Graf, C. H.	active.
Wood, A. C.	"	Nutting, C. H.	"
Clark, W.	active.	Shelton, F. H.	"
Gould, J. A.	"	Waters, J. A.	"

1896.

Alden, G. A.	active.	Hurlburt, S.	active.
Burritt, D. F.	"	Mansfield, G. W.	"
Cowperthwaite, G. E.	"	Morrison, H. K.	"
Dickens, J.	"	Burrage, A. C.	assoc.

Wardwell, W. R., assoc.

1897.

Allen, B. J.	active.	Shaw, H. S.	active.
Cook, R. W.	"	Stearns, W. M.	"
Crafts, H. C.	"	Terry, F. L.	"
Goulding, N. O.	"	Cheney, H. N.	assoc.
Learned, C. A.	"	Dunbar, A.	"
McGregor, W.	"	Fiske, J. T.	"
Sargent, F. H.	"	Macmun, G. F., Jr.	"

Tudor, F. J., assoc.

1898.

Barnum, D. D.	active.	Lawrence, W. F.	active.
Crawford, R.	"	Moynahan, J. F.	"
Dole, C. E.	"	Norton, P. T.	"
Farnum, G. W.	"	Williams, E. H.	"
Humphreys, J. J., Jr.	"	Young, A. M.	"

1899.

Darbee, W.	active.	Miller, C.	active.
Eccles, A. D.	"	Barnes, A. M.	assoc.
Lucey, F. J.	"	Norton, A. E.	"

Scranton, G. H., assoc.

1900.

Hirt, L. D.	active.	Travis, F. M.	active.
Milne, J. D.	"	Walker, W. L.	"

White, C. E., active.

1901.

Erhard, T.	active.	Chandler, F. C.	assoc.
Gillette, S. E.	"	Cheney, C. H.	"
Hawken, T.	"	Davidson, R.	"
Lawson, W. H.	"	Farrington, A. N.	"
Leonard, C. F.	"	Finn, G. H.	"
Macomber, G. E.	"	Gardiner, W. H.	"
Miles, C. H.	"	Greims, A. F.	"
Morse, G. W.	"	Hamlin, H. R.	"
Spear, J. N.	"	Hill, W. H.	"
Stone, A. F.	"	Huestis, F. C.	"
Thompson, C. F.	"	Humphreys, F. W.	"
Austin, C.	assoc.	Montgomery, J. K.	"
Baker, S. E.	"	Nichols, W. B.	"
Baldwin, C. H.	"	Plunkett, W. R.	"
Brown, G. P.	"	Wilder, C. C.	"

Ruggles, C. S. J., assoc.

1902.

Barnes, W. M.	active.	Tenney, A. B.	active.
Blodgett, C. W.	"	Walker, E. M.	"
Campbell, A. J.	"	Chancey, F. V.	assoc.
Ellis, J. W.	"	Fraser, E. B.	"
Fish, R. C.	"	Griswold, C. S.	"
McKnight, G.	"	Piser, T. H.	"
Slater, H. C.	"	Stafford, T. H.	"
Stevens, C. F.	"	Thompson, F. de V.	"

1903.

Bill, B. P.	active.	Gifford, C. H.	active.
Brockingham, F. T.	"	Leland, G. B.	"
Brown, J. S.	"	Lomax, C.	"
Cathels, E.	"	Philbrick, J. E.	"
Corson, F. H.	"	Polk, R. W.	"
Earle, A. G.	"	Tait, F. M.	"

Wing, J. F., active.

Barnes, F. G. P.	[illegible]	Magee, J.	[illegible]
Campbell, W. E.	"	[illegible], H.	"
C[illegible], C. P.	"	M[illegible], G. S.	"
Drexel, W. L.	"	Russell, D. D.	"
D[illegible], F. B.	"	Starkweather, R. M.	"
Hall, A. S.	"	Tucker, C. A.	"
Kerr, J. B.	"	White, H. E.	"

Deceased.

Giles, A. M.	1873	Stimson, S. G.	1895
Mace, A.	1873	Tarbell, W.	1895
Perry, W. H.	1878	Hadley, J. A.	1895
Harriman, R. R.	1878	Thomas, J. R.	1897
Raymond, B.	1879	Wood, G.	1897
Edge, G. W.	1880	Yorke, W.	1898
Dwight, G.	1882	Norton, F. W.	1898
Coliath, C.	1882	Parker, A. H.	1898
Dresser, G. W.	1884	Rogers, J. F.	1898
Price, W. H.	1884	Cabot, G. D.	1898
Howe, E.	1887	Warren, G. F.	1899
Taber, W. C.	1887	Greenough, W. W.	1900
Brayton, D.	1888	Gerould, L. P.	1900
Fowler, S.	1889	Wetherby, G. E.	1900
Cushing, O. E.	1890	Hill, J. M.	1901
Roome, C.	1891	Atwood, H. A.	1901
Andrew, J.	1892	Thompson, G. T.	1901
McIlhenny, G. A.	1893	Smith, R. R.	1901
Copp, A. M.	1893	Twitchell, F. H.	1901
Woodman, E. H.	1893	Blood, F. C.	1902
Norton, A. M.	1893	Crafts, D. W.	1902
Jones, E.	1894	Neal, G. B.	1902
Tufts, N.	1894	Leach, H. B.	1903
		Stedman, W. A.,	1903

A LIST OF THE PAPERS

Read before the

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS

and published in the American Gas Light Journal
on the date given.
This list is Chronologically Arranged, Without Classification.

Spontaneous Combustion,	J. H. Armington,	Apr.	2, 1875
Napthalene,	F. C. Sherman,	Apr.	3, 1876
Tests of Penn. Coal,	C. D. Lamson,	Apr.	3, 1876
Coal Gas,	Dr. Kidder,	Mar.	2, 1876
Testing Meters,	F. C. Sherman,	Apr.	2, 1877
Burners,	C. D. Lamson,	Apr.	16, 1877
Temperature Tests,	M. S. Greenough,	Apr.	16, 1877
Statistics (Processes),	J. H. Armington,	Apr.	16, 1877
Statistics, (Oil Production),	C. H. Nettleton,	May	2, 1877
Charging Alternately,	M. S. Greenough,	Apr.	2, 1878
Removal and Prevention of Carbon,	F. C. Sherman,	Apr.	2, 1878
Gas Analysis (Topic),	W. W. Goodwin,	Apr.	16, 1878
Street Main Joints (Topic),	J. R. Thomas,	May	2, 1878
Reburning Foul Lime,	G. W. Dresser,	Apr.	2, 1879
Davison Retort,	G. B. Neal,	Apr.	16, 1879
Large and Small Retorts,	A. B. Slater,	Sept.	2, 1879
Value of Statistics,	W. A. Stedman,	Mar.	16, 1880
Value of Tar as Fuel (Topic),	G. D. Cabot, et al.	Mar.	16, 1880
Heating Retorts by Furnaces,	M. S. Greenough,	Apr.	2, 1880
Coke, Its Preparation and Use (Topic),	C. D. Lamson, et al.	Apr.	2, 1880
Gas for Cooking, Heating and Motive Power (Topic),	W. W. Goodwin, et al.	Apr.	16, 1880
Dieterich Furnace,	C. H. Nettleton,	Mar.	16, 1881
Standard Scrubber,	W. A. Stedman,	Apr.	2, 1881
Testing Meters (Topic),	Neal, Harbison, Cabot, et al.	Apr.	2, 1881
Heating Gas (Topic),	Spaulding, et al.	Apr.	2, 1881
Finding Breaks (Topic),	Gerould, et al.	Apr.	2, 1881
Preservation of Service Pipes (Topic),	Neal, et al.	Apr.	2, 1881
Purification and Iron Sponge (Topic),	Coggeshall, et al.	Apr.	2, 1881
Gas Stoves (Topic),	Goodwin, Taber, et al.	Apr.	16, 1881
Iron Sponge (Topic),	Connelly, Greenough, et al.	Apr.	16, 1881
Foul Lime (Topic),	Stiness, Crafts, et al.	Apr.	16, 1881
Purification of Gas,	S. G. Stiness,	Mar.	2, 1882
Tar as Fuel,	F. C. Sherman,	Mar.	16, 1882

Retort Furnaces Topic	Sherman, Nettleton, et al.	Mar. / Apr.	16, / 3,	1882 / 1882
Ammoniacal Liquor Topic.	Taber, Neal, Greenough, et al.	Apr.	3,	1882
Gas for Fuel Topic.	Taber, Harmon, Stone, et al.	Apr.	3,	1882
Gas Stoves for Cooking and Heating	R. B. Taber.	Sept.	2,	1882
Half-Hourly Observations of the Heat and c. p. of Gas.	W. A. Learned.	Mar.	16,	1883
Steam Heating vs. Gas Heating.	F. C. Sherman.	Apr.	2,	1883
Yield of Coke per Ton of Coal.	H. A. Allyn.	Apr.	2,	1883
Comparative Value of Retorts.	William Yorke.	Apr.	2,	1883
Regenerator Furnaces.	W. A. Stedman.	Apr.	17,	1883
Red Brick in Bench work	H. A. Allyn.	Mar.	17,	1884
The Benzine Series in Gas.	R. B. Taber.	Mar.	17,	1884
Some Modifications of the Dietrich Furnace	Charles H. Nettleton.	Mar.	17,	1884
New Works of the Pawtucket Gas Co.	S. G. Stiness.	Mar. / Apr.	17, / 2,	1884 / 1884
Vigilance is the Price of Success in Gas Making.	*These papers were submitted in prize competition and afterwards withdrawn.*	Apr.	16,	1884
The Weakening of Mains by Tapping.		Apr.	16,	1884
The Influence of Steam in the Ash Pan.	C. F. Prichard.	Apr.	2,	1885
An Experience with Napthalene Deposits.	E. C. Jones.	Apr.	16,	1885
Fuel Gas.	C. F. Prichard.	Mar.	2,	1886
Experience in the Manufacture of Water Gas.	J. H. Rollins.	Mar.	16,	1886
Results in the Use of a Hydraulic Main.	S. G. Stiness.	Mar.	16,	1886
Construction and Cost of a Gasholder Tank.	W. A. Stedman.	Apr.	2,	1886
Notes on the Construction of a Gasholder Tank.	A. B. Slater.	Apr.	2,	1886
Effect of Reduction in Price of Gas.	A. M. Morton.	May	2,	1887
Purification of Gas by Iron Oxide.	C. J. R. Humphreys.	Mar.	2,	1887
The Treatment of Napthalene.	E. G. Pratt.	Mar.	2,	1887
Candle Power and Illumination.	C. F. Prichard.	Mar.	2,	1887
Units of Photometry.	R. B. Taber.	Mar.	2,	1887
The Introduction of High Candle Power Burners.	F. S. Richardson,	Mar.	2,	1887
The Introduction of High Candle Power Burners,	H. A. Allyn.	Mar.	2,	1888
Items From a Superintendent's Note-Book,	W. A. Wood.	Mar.	2,	1888
The Running of Small Gas Works,	J. R. Todd.	Mar.	2,	1888
A New Way of Utilizing Ammoniacal Liquor,	C. J. R. Humphreys,	Mar.	2,	1888
A Vagary of Napthalene,	W. H. Snow,	Mar.	2,	1888
Candle Power and Illumination,	R. B. Taber and C. F. Prichard,	Mar.	16,	1888
My Experience with Coal Tar and the Walker Tar Extractor,	C. A. Gerdinier,	Mar.	16,	1888
A Leakage Experience at Prov., R. I.,	A. B. Slater,	Mar.	16,	1888
The Elements of Gas Analysis,	E. C. Jones,	Mar.	4,	1889
Lima Crude Oil vs. Cannel Coal,	J. L. Hallett,	Mar.	4,	1889
Incidents in the Life of a Superintendent of a Small Gas Works,	A. F. Cooper,	Mar.	4,	1889
The Composition of Boston Gas,	L. M. Norton,	Mar.	11,	1889

Experience with a Springer Cupola,	H. S. Chase,	Mar. 11, 1889
Photometric Standards,	C. F. Prichard and R. B. Taber,	Mar. 11, 1889
Breaking Coke,	F. C. Sherman,	Mar. 18, 1889
Artistic Articles Used in Connection with Artificial Lighting,	R. J. Monks,	Mar. 18, 1889
Gas and Electricity,	S. G. Stiness,	Mar. 18, 1889
Municipal Control of Gas and Electric Lighting,	Dr. Armory,	Mar. 3, 1890
Revivification of Oxide of Iron,	W. A. Learned,	Mar. 10, 1890
Some Experiments in the Photometer Room,	N. W. Gifford,	Mar. 10, 1890
Difference in the Eastern and Western Methods of Management of Gas Works,	E. G. Pratt,	Mar. 10, 1890
Why I Shall Make Water Gas,	A. B. Slater,	Mar. 10, 1890
A Few of the Advantages of Water Gas Over Coal Gas for Small Works,	F. H. Parker,	Mar. 10, 1890
Various Methods of Introducing Gas Stoves,	H. A. Norton,	Mar. 10, 1890
Management of a Small Gas and Electric Light Plant,	S. J. Fowler,	Mar. 10, 1890
Some Notes Taken in a Small Gas Works,	Ralph Woodward,	Mar. 10, 1890
Vaporization and Feed of Oil to Generator and Retort,	W. R. Addicks,	Mar. 17, 1890
Problems Constantly Before the Gas Manager,	E. H. Yorke,	Mar. 17, 1890
A Point or Two in Regard to Illuminants During Condensation and Purification,	G. F. Goodnow,	Mar. 24. 1890
A Chapter of Don'ts,	W. H. Snow,	Mar. 24, 1890
Some Experiments on the Rate of Purification,	G. F. Goodnow,	Mar. 2, 1891
Trouble in Purifying Gas from Sulphurous Coals,	N. W. Gifford,	Mar. 2, 1891
Unaccounted for Gas in Coal Gas Works Cause, Remedy and Results,	L. P. Gerould,	Mar. 9, 1891
Note Books—The Value and How to Keep Them,	C. D. Lamson,	Mar. 9, 1891
Repairing Holder Tanks,	F. C. Sherman,	Mar. 9, 1891
Residuals,	G. S. Page,	Mar. 16, 1891
Different Methods and Devices for Accomplishing Similar results,	H. A. Allyn,	Mar. 16, 1891
Desirability and Advantage of Gas Companies Owning and Operating a Combined Plant,	F. S. Richardson,	Feb. 29, 1892
Wood Gas Mains,	Mr. Saville,	Feb. 29, 1892
Description of New Gas and Electric Plant of the Brookline Gas Company,	Robert Amory,	Mar. 7, 1892
Wrinkles,	H. H. Kelly,	Mar. 7, 1892
A Gas Works as a Heat Engine,	W. E. McKay,	Mar. 7, 1892
Manipulation of Oxide,	W. A. Wood,	Mar. 21, 1892
Oxide Purification,	L. M. Jenks,	Mar. 21, 1892
Results Obtained With Deep Furnaces,	F. C. Sherman,	Mar. 21, 1892
Experiments on Removing Sulphur from Purified Gas,	G. F. Goodnow,	Feb. 27, 1893

Reports,	R. W. Bush,	Feb. 27, 1893
Effects of the Trolley System on Gas and Water Pipes,	H. A. Allyn,	Mar. 6, 1893
Recording Pressures on Mains and Services,	S. J. Fowler,	Mar. 6, 1893
Every-Day Pyrometry,	E. C. Jones,	Mar. 13, 1898
Removal of Carbon from Retorts Without the Use of the Steam Jet,	C. D. Sherman,	Mar. 13, 1893
Value of an All-Round Man,	C. F. Spaulding,	Mar. 13, 1893
Advantages of a Combined Coal and Water Gas Plant,	C. J. R. Humphreys,	Mar. 5, 1894
Effect of Electric Railway Return Currents Upon Gas Pipes,	W. R. Addicks,	May 12, 1894
The Storage and Measurement of Enriching Oils,	W. E. McKay,	Mar. 12, 1894
Lime Boxes for Removing CO_2,	N. W. Gifford,	Mar. 19, 1894
The Gas Industry in 1886 and 1892,	R. B. Taber,	Mar. 19, 1894
The Fuel Value of Coke and Tar,	F. C. Sherman,	Mar. 19, 1894
Federation, (Resolution)		Mar. 19, 1894
A Cubic Foot of Gas,	C. D. Lamson,	Not P'bl'shed
The Course to Pursue When a Person is Overcome by Gas Inhalation,	Dr. Amory,	Feb. 25, 1895
The Effect of the Introduction of the Welsbach Lamps on the Business of the Gas Company,	J. E. Nute,	Feb. 25, 1895
Distribution of the Work of Boiler Fuel in Water Gas Manufacture,	W. A. Wood,	Mar. 4, 1895
Electrolysis (Topic),	W. R. Addicks,	Mar. 4, 1895
Some Card Catalogues in Use for Record of the Outside Work of a Gas Company,	S. J. Fowler,	Mar. 4, 1895
Carbide of Calcium (Topic),	C. W. Hinman, et al.,	Mar. 11, 1895
Some Notes on Photometry,	C. W. Hinman,	Mar. 2, 1896
The Development of Candle Power,	W. S. Allen,	Mar. 9, 1886
Acetylene Gas,	W. R. Addicks,	Mar. 9, 1896
Temperature Corrections,	N. W. Gifford,	Mar. 16, 1896
The Welsbach Light,	George Barrows,	Mar. 16, 1896
Should Gas Holders in New England Be Housed or Not,	F. H. Shelton,	Mar. 23, 1896
Napthaline (Topic),	F. C. Sherman, et al.,	Mar. 23, 1896
Day Output,	N. W. Gifford,	Mar. 1, 1897
Extraction of Ammonia from Spent Oxide,	C. H. Graf,	Mar. 1, 1897
Gas Distribution,	W. H. Snow,	Mar. 8, 1897
Temperature,	W. E. McKay,	Mar. 8, 1897
Coke Ovens and Their Products,	S. J. Fowler,	Mar. 8, 1897
Separate Meters and Special Prices for Gas Stove Consumption,	F. S. Richardson,	Mar. 15, 1897
The Measurement of Gas,	C. W. Hinman,	Mar. 15, 1897
Reports of Gas Leaks—Their Management by a Large Gas Company,	W. R. Addicks,	Mar. 22, 1897
Calorimetry,	C. D. Jenkins,	Mar. 22, 1897
Experiences at Fitchburg, 1853–1896,	H. F. Coggeshall,	Mar. 22, 1897
Gas Holder Construction,	H. A. Allyn,	Feb. 28, 1898
Some Notes on European Gas Matters,	W. S. Allen,	Mar. 7, 1898
Some Incandescent Gas Burners,	N. W. Gifford,	Mar. 7, 1898
The Winning Ways of Gas,	W. McGregor,	Mar. 14, 1898
A Paper Unnamed,	T. H. Hintze,	Feb. 27, 1899

Distributing Gas at Pressures Higher Than Usually Obtained With a Holder,	B. J. Allen,	Feb. 27, 1899
Notes on the Design and Extension of a Gas Plant,	J. J. Humphreys,	Mar. 6, 1899
Correspondence Schools,	A. C. Humphreys,	Mar. 6, 1899
Advertising,	H. K. Morrison,	Mar. 6, 1899
The Nuisance Question in Gas Works,	F. H. Shelton,	Mar. 6, 1899
Notes on the Use of Superheated Steam for Burning Carbon From Retorts,	N. W. Gifford,	Mar. 6, 1899
Steam,	W. E. McKay,	Mar. 13, 1899
The Question of Enrichers,	E. H. Yorke,	Mar. 13, 1899
Possibilities,	J. A. Waters,	Mar. 13, 1899
Tar Burning,	F. C. Sherman,	Mar. 13, 1899
A Beginner's Experiments in Studying the Operations of a Lowe Water Gas Apparatus,	R. W. Polk,	Mar. 13, 1899
Pumping Gas Five Miles at Twenty Pounds Pressure,	F. H. Shelton,	Mar. 5, 1900
Then, Now and Later,	J. A. Waters,	Mar. 12, 1900
Oven and Retort House Construction and Results, (Topic)	L. J. Hirt, F. Mayer, et al.,	Mar. 12, 1900
Four Years' Experience With Prepayment Meters,	N. O. Goulding,	Mar. 12, 1900
Under Water Gas Main Construction. (Topic)	J. A. Coffin, J. A. Gould, A. B. Slater, L. J. Hirt, et al.,	Mar. 19, 1900
Some Notes on Oil and Tar Burning,	B. J. Allen,	Mar. 26, 1900
Remarks on Gas Purification,	S. J. Fowler,	Mar. 4, 1901
Proportion of Sulphur Removed in Each Purifying Box,	C. Miller,	Mar. 4, 1901
Gas Lighting at the Paris Exposition,	W. S. Allen,	Mar. 4, 1901
A Test of a Gas Engine Electric Lighting Plant,	H. N. Cheney,	Mar. 11, 1901
Some Sketches on Gas Governors,	J. J. Humphreys, Jr.,	Mar. 11, 1901
Selling Gas,	C. J. R. Humphreys,	Mar. 18, 1901
How They Do Things on the Other Side,	F. H. Shelton,	Mar. 18, 1901
Inclined Retorts (Topic),	F. Egner, et al.,	Mar. 25, 1901
Otto-Hoffman Coke Oven Practice,	F. Schniewind,	Mar. 25, 1901
Distributing Artificial Gas at High Pressure in a Suburban Locality,	G. F. Goodnow,	Mar. 3, 1902
House Piping,	G. S. Griswold,	Mar. 10, 1902
What Is a Gas Company,	F. S. Richardson,	Mar. 10, 1902
A Model Coal Shed,	T. J. Hintze,	Mar. 17, 1902
The Advantages of the Card System in Gas Ledgers,	F. M. Barnes,	Mar. 17, 1902
Selling Gas (Com. Report),	C. J. R. Humphreys,	Mar. 17, 1902
Some Details in the Operation of a Water Gas Plant,	C. F. Leonard,	Mar. 24, 1902
Coal Gas Treatment,	A. B. Slater, Jr.	Mar. 24, 1902 Mar. 31, 1902
Building a Holder Foundation on Quicksand,	C. A. Learned,	Mar. 31, 1902
Notes on Candle Power Determinations,	C. W. Hinman,	Mar. 31, 1902
Gas Engines,	G. F. Macmun, Jr.,	Mar. 31, 1902

This List of Papers read before the N. E. A. of G. E. is Classified by Topics, and Arranged Chronologically.

[Date of publication in the *American Gas Light Journal* is also given.]

Plant.

Statistics (Processes)	Col. J. H. Armington,	Apr. 16, 1877
The Davison Retort,	G. B. Neal,	Apr. 16, 1879
Large and Small Retorts,	A. B. Slater,	Sept. 2, 1879
The Dieterich Furnace,	C. H. Nettleton,	Mar. 16, 1881
The Standard Scrubber,	W. A. Stedman,	Apr. 2, 1881
Retort Furnaces (Topic),	Stedman, Nettleton, et al.,	Mar, 16, 1882
Regenerator Furnaces,	W. A. Stedman,	Apr. 17, 1883
Red Brick in Bench Work,	H. A. Allyn,	Mar. 17, 1884
Some Modifications of the Dieterich Furnace,	Chas. H. Nettleton,	Mar. 17, 1884
New Works of the Pawtucket Gas Co.,	S. G. Stiness,	Mar. 17, 1884 Apr. 2, 1884
Fuel Gas.	C. F. Prichard,	Mar. 2, 1886
Results obtained with deep Furnaces,	F. C. Sherman,	Mar. 21, 1892
Coke Ovens and their Products,	S. J. Fowler,	Mar. 8, 1897
Notes on the Design and Extension of Gas Plant,	J. J. Humphreys,	Feb. 27, 1899
Oven and Retort House Construction and Results (Topic),	L. J. Hirt, F. Mayer, et al.,	Mar. 12, 1900
Inclined Retorts (Topic),	F. Egner, et al.,	Mar. 25, 1901
Otto Hoffman Coke Oven Practice,	F. Schniewind,	Mar. 25, 1901

Material.

Statistics (Oil Production),	Chas. H. Nettleton,	May 2, 1877
Lima Crude Oil versus Cannel Coal,	J. L. Hallett,	Mar. 4, 1889
The Question of Enrichers,	E. H. Yorke,	Mar. 13, 1899

Manufacture.

Tests of Penn. Coal,	C. D. Lamson,	Apr. 3, 1876
Coal Gas,	Dr. Kidder,	Mar. 2, 1876
Temperature Tests,	M. S. Greenough,	Apr. 16, 1877
Charging Alternately,	M. S. Greenough,	" 2, 1878
Removal and Prevention of Carbon,	F. C. Sherman,	" 2, 1875
Heating Retorts by Furnaces,	M. S. Greenough,	" 2, 1880
Half-Hourly Observations of the Yield and c. p. of Gas,	W. A. Learned,	Mar. 16, 1883
Comparative Value of Retorts,	William Yorke,	Apr. 2, 1883
The Influence of Steam in the Ash-Pan,	C. F. Prichard,	" 2, 1885
Results in the Use of a Hydraulic Main,	S. G. Stiness,	Mar. 16, 1886
Items From a Superintendent's Note-Book,	W. A. Wood,	Mar. 2, 1888

Some Notes Taken in a Small Gas Works,	Ralph Woodward,	Mar.	10, 1890
Different Methods and Devices for Accomplishing Similar Results.	H. A. Allyn,	Mar.	16, 1891
A Gas Works as a Heat Engine,	W. E. McKay,	"	7, 1892
Removal of Carbon From Retorts Without the Use of the Steam Jet,	C. D. Sherman,	Mar.	13, 1893
Notes on the Use of Superheated Steam in Burning Carbon From Retorts,	N. W. Gifford,	Mar.	6, 1899
Steam,	W. E. Mckay,	"	13, 1899
Then, Now, and Later.	J. A. Waters,	"	12, 1900
Coal Gas Treatment,	A. B. Slater, Jr.,	"	24, 1902
		"	31, 1902

Water Gas.

Experience in the Manufacture of Water Gas,	J. H. Rollins,	Mar.	16, 1886
Experience With a Springer Cupola,	H. S. Chase,	"	11, 1889
Why I Shall Make Water Gas,	A. B. Slater,	"	10, 1890
A Few of the Advantages of Water Gas Over Coal Gas for Small Works,	F. H. Parker,	Mar.	10, 1890
Vaporization and Feed of Oil to Generator and Retort,	W. R. Addicks,	Mar.	17, 1890
Advantages of a Combined Coal and Water Gas Plant,	C. J. R. Humphreys,	Mar.	5, 1894
Distribution of the Work of Boiler Fuel in Water Gas Manufacture,	W. A. Wood,	Mar.	4, 1895
A Beginner's Experiments in Studying the Operations of a Lowe Water Gas Apparatus,	R. W. Polk,	Mar.	13, 1899
Some Details in the Operation of a Water Gas Plant,	C. F. Leonard,	Mar.	24, 1902

Purification.

Reburning Foul Lime;	G. W. Dresser,	Apr.	2, 1879
Purification of Iron Sponge, (Topic)	Slater, Coggeshall, et al.	Apr.	2, 1881
Iron Sponge, (Topic)	Connelly, Greenough, et. al.	Apr.	16, 1881
Foul Lime, (Topic)	Stiness, Crafts, et al.,	"	16, 1881
Puiification of Gas,	S. G. Stiness,	Mar.	2, 1882
Purification of Gas by Iron Oxide,	C. J. R. Humphreys,	"	2, 1887
Revivification of Oxide of Iron,	W. A. Learned,	"	10, 1890
A Point or Two in Regard to Illuminants During Condensation and Purification,	G. F. Goodnow,	Mar.	2, 1890
Some Experiments on the Rate of Purification,	G. F. Goodnow,	Mar.	2, 1891
Trouble in Purifying Gas from Sulphurous Coals,	N. W. Gifford,	Mar.	2, 1891
Manipulation of Oxide,	W. A. Wood,	"	21, 1892
Oxide Purification,	L. M. Jenks,	"	21, 1892

Experiments on Removing Sulphur From Purified Gas,	G. F. Goodnow,	Feb.	27, 1893
Lime Boxes for Removing CO_2,	N. W. Gifford,	Mar.	19, 1894
Remarks on Gas Purification,	S. J. Fowler,	"	4, 1901
Proportion of Sulphur Removed in Each Purifying Box,	C. Miller,	Mar.	4, 1901

Storage.

Construction and Cost of a Gas Holder Tank,	W. A. Stedman,	Apr.	2, 1886
Notes on the Construction of a Gas Holder Tank,	A. B. Slater,	Apr.	2, 1886
Repairing Holder Tanks,	F. C. Sherman,	Mar.	9, 1891
The Storage and Measurement of Enriching Oils,	W. E. McKay,	Mar.	12, 1894
Should Gas Holders in New England Be Housed, or Not?	F. H. Shelton,	Mar.	23, 1896
Gas Holder Construction,	H. A. Allyn,	Feb.	28, 1898
A Model Coal Shed,	T. J. Hintze,	Mar.	17, 1902
Building a Holder Foundation on Quicksand,	C. A. Learned,	Mar.	31, 1902

Distribution.

Napthalene,	F. C. Sherman,	Apr.	3, 1876
Testing Meters,	F. C. Sherman,	"	2, 1877
Street Main Joints,	J. R. Thomas,	May	2, 1878
Testing Meters, (Topic)	Neal, Harbison, Cabot, et al ,	Apr.	2, 1881
Stealing Gas, (Topic)	Spaulding, et al.,	"	2, 1881
Finding Breaks, (Topic)	Gerould, et al.,	"	2, 1881
The Preservation of Service Pipes, (Topic)	Neal, Allyn, et al.,	Apr.	2, 1881
The Weakening of Mains by Tapping,		"	16, 1884
An Experience With Napthalene Deposits,	E. C. Jones,	Apr.	16, 1885
The Treatment of Napthalene,	E. G. Pratt,	Mar.	2, 1887
A Vagary of Napthalene,	W. H. Snow,	"	2, 1888
A Leakage Experience at Providence, R. I.,	A. B. Slater,	Mar.	16, 1888
Unaccounted For Gas in Coal Gas Works — Cause, Remedy and Results,	L. P. Gerould,	Mar.	9, 1891
Wood Gas Mains,	Mr. Saville,	Feb.	29, 1892
Recording Pressures on Mains and Services	S. J. Fowler,	Mar.	6, 1893
Some Card Catalogues in Use for the Record of the Outside Work of a Gas Co.,	S. J. Fowler,	Mar	4, 1895
Napthalene, (Topic)	F. C. Sherman, et al.,	"	23, 1896
Day Output,	N. W. Gifford,	"	1, 1897
Gas Distribution,	H. H. Snow,	"	8, 1897
The Measurement of Gas,	C. W. Hinman,	"	15, 1897

Reports of Gas Leaks; their Management by a Large Gas Company,	W. R. Addicks,	Mar. 22, 1897
Distributing Gas at Pressures Higher than Usually Obtained with a Holder,	B. J. Allen,	Feb. 27, 1899
Pumping Gas Five Miles at 20 lbs. Pressure,	F. H. Shelton,	Mar. 5, 1900
Four Years Experience with Pre-payment Meters,	N. O. Goulding,	Mar. 12, 1900
Under Water Gas Main Construction, (Topic),	J. A. Coffin, J. A. Gould, A. B. Slater, L. J. Hirt, et al.,	Mar. 19, '00
Some Sketches of Gas Governors,	J. J. Humphreys, Jr.,	Mar. 11, 1901
Distributing Artificial Gas at High Pressure in the Suburban Locality,	G. F. Goodnow,	Mar. 3, 1902
House Piping,	C. S. Griswold,	" 10, 1902

Lighting.

Burners,	C. D. Lamson,	Apr. 16, 1877
The Introduction of High Candle Power Burners,	F. S. Richardson,	Mar. 2, 1887
The Introduction of High Candle Power Burners,	H. A. Allyn,	Mar. 2, 1888
Candle Power and Illumination,	R. B. Taber and C. F. Prichard,	Mar. 16, 1888
Artistic Articles used in Connection with Artificial Lighting,	R. J. Monks,	Mar. 18, 1889
The Effects of the Introduction of the Welsbach Lamps on the Business of the Gas Co.,	J. E. Nute,	Feb. 25, 1895
The Welsbach Light,	George Barrows,	Mar. 16, 1896
Some Incandescent Gas Burners,	N. W. Gifford,	" 7, 1898
Gas Lighting at the Paris Exposition,	W. S. Allen,	" 4, 1901

Heating.

Gas for Cooking, Heating and Motive Power, (Topic),	W. W. Goodwin, et al.,	Apr. 2, 1880
Gas Stoves, (Topic),	Goodwin, Taber, et al.,	" 16, 1881
Gas for Fuel, (Topic),	Taber, Harbison, Starr, et al.,	Apr. 3, 1882
Gas Stoves for Cooking and Heating,	R. B. Taber,	Sept. 2, 1882
Steam Heating vs. Gas Heating,	F. C. Sherman,	Apr. 2, 1883

Power.

A Test of a Gas Engine Electric Lighting Plant,	H. N. Cheney,	Mar. 11, 1901
Gas Engines,	G. F. Macmun, Jr.,	" 31, 1902

Residuals.

Value of Tar as Fuel,	G. D. Cabot, et al.,	Mar. 16, 1880
Coke, its Preparation and Use,	C. D. Lamson, et al.,	Apr. 2, 1880
Tar as Fuel,	F. C. Sherman,	Mar. 16, 1882
Ammoniacal Liquor, (Topic),	Taber, Neal, Greenough et al.,	Apr. 3, 1882
Yield of Coke per ton of Coal,	H. A. Allyn,	" 2, 1883
A New Way of Utilizing Ammoniacal Liquor,	C. J. R. Humphreys,	Mar. 2, 1888
My Experience with Coal Tar and the Walker Extractor,	C. A. Gerdinier,	Mar. 16, 1888
Breaking Coke,	F. C. Sherman,	" 18, 1889
Residuals,	G. S. Page,	" 16, 1891
The Fuel Value of Coke and Tar,	F. C. Sherman,	" 19, 1894
Extraction of Ammonia from Spent Oxide,	C. H. Graf,	Mar. 1, 1897
Tar Burning,	F. C. Sherman,	" 13, 1899
Some Notes on Oil and Tar Burning,	B. J. Allen,	" 26, 1900

Photometry.

Candle Power and Illumination,	C. F. Prichard,	Mar. 2, 1887
Units of Photometry,	R. B. Taber,	" 2, 1887
Photometric Standards,	C. F. Prichard, R. B. Taber,	Mar. 11, 1889
Some Experiments in the Photometer Room,	N. W. Gifford,	Mar. 10, 1890
Some Notes on Photometry,	C. W. Hinman,	" 2, 1896
The Development of Candle Power,	W. S. Allen,	" 9, 1896
Notes on Candle Power Determinations,	C. W. Hinman,	" 31, 1902

Chemical.

Spontaneous Combustion,	Col. J. H. Armington,	Apr. 2, 1875
Gas Analysis,	W. W. Goodwin,	" 16, 1878
The Elements of Gas Analysis,	E. C. Jones,	Mar. 4, 1889
The Composition of Boston Gas,	L. M. Norton,	" 11, 1889
Every-Day Pyrometry,	E. C. Jones,	" 13, 1893
Temperature Corrections,	N. W. Gifford,	" 16, 1896
Temperature,	W. E. McKay,	" 8, 1897
Calorimetry,	C. D. Jenkins,	" 22, 1897

Electrical.

Gas and Electricity,	S. G. Stiness,	Mar. 18, 1889
Desirability and Advantage of Gas Companies Owning and Operating a Combined Plant,	F. S. Richardson,	Feb. 29, 1892
Description of New Gas and Electric Plant of the Brookline Gas Co.,	Robert Amory,	Mar. 7, 1892
Effects of the Trolley System on Gas and Water Pipes,	H. A. Allyn,	Mar. 6, 1893
Effect of Electric Railway Return Currents Upon Gas Pipes,	W. R. Addicks,	Mar. 12, 1894
Electrolysis, (Topic),	W. R. Addicks,	" 4, 1895

Management.

Vigilance is the Price of Success in Gas Making,		Apr.	16, 1884
Effect of Reduction in Price of Gas,	A. M. Norton,	May	2, 1887
Incidents in the Life of a Superintendent of a Small Gas Works,	A. F. Cooper,	Mar.	4, 1889
The Running of Small Gas Works,	J. R. Todd,	"	2, 1888
Municipal Control of Gas and Electric Lighting,	Dr. Amory,	Mar.	3, 1890
Differences in the Eastern and Western Methods of Management of Gas Works,	E. G. Pratt,	Mar.	10, 1890
Various Methods of Introducing Gas Stoves,	H. A. Norton,	Mar.	10, 1890
Management of Small Gas and Electric Light Plant,	S. J. Fowler,	Mar.	10, 1890
Problems Constantly Before the Gas Manager,	E. H. Yorke,	Mar.	17, 1890
A Chapter of Don'ts,	H. H. Snow,	"	24, 1890
Separate Meter and Special Prices for Gas Stove Consumption,	F. S. Richardson,	Mar.	15, 1897
The Winning Ways of Gas,	W. McGregor,	"	18, 1898
Selling Gas,	C. J. R. Humphreys,	"	18, 1901
The Advantages of the Card System in Gas Ledgers,	A. M. Barnes,	Mar.	17, 1902
Selling Gas, (Com. Report),	C. J. R. Humphreys,	"	17, 1902

Miscellaneous.

The Value of Statistics,	W. A. Stedman,	Mar.	16, 1880
Note-Books—Their Value and How to Keep Them,	C. D. Lamson,	Mar.	9, 1881
Wrinkles,	H. H. Kelly,	"	7, 1892
Reports,	R. W. Bush,	Feb.	27, 1893
Value of an All Round Man,	C. F. Spaulding,	Mar.	13, 1893
The Gas Industry in 1886–1892,	R. B. Taber,	"	19, 1894
Federation, (Resolution),		"	19, 1894
A Cubic Foot of Gas,	C. D. Lamson,	Not Published	
The Course to Pursue when a Person is Overcome by Gas Inhalation,	Dr. Amory,	Feb.	25, 1895
Carbide of Calcium, (Topic),	C. W. Hinman, et al.,	Mar.	11, 1895
Acetylene Gas,	W. R. Addicks,	"	9, 1896
Experiences at Fitchburg 1853-1896,	H. F. Coggeshall,	"	22, 1897
Some Notes on European Gas Matters,	W. S. Allen,	"	7, 1898
A Paper Un-named,	T. H. Hintze,	Feb.	27, 1899
Correspondence Schools,	A. C. Humphreys,	Mar.	6, 1899
Advertising,	H. K. Morrison,	"	6, 1898
The Nuisance Question in Gas Works,	F. H. Shelton,	"	6, 1899
Possibilities,	J. A. Waters,	"	13, 1899
How They Do Things on the Other Side,	F. H. Shelton,	"	18, 1901
What is a Gas Company,	F. S. Richardson,	"	10, 1902

A Partial List of Questions which became Topics of Discussion.

The use of the Question Box was begun in 1884.

Plant.

Is a Pipe Around the Retort House, Between the Hydraulic and Exhauster of any Practical Value?	Apr. 16, 1885
Is There any Economy in Having Thick-Sided Retorts?	Mar. 11, 1895
In Double Stacks of Retorts; Which Arrangement is Preferable: To Have the Benches Set Back to Back, or Facing Each Other?—With Operating Floor Between?	Mar. 19, 1900
Why Separate the Exhauster Room from the Condenser Room?	Mar. 17, 1902

Manufacture.

Which is the Better Enricher: Cannel or Petroleum?	May 2, 1884
Does it Pay to Use Bye-Pass Dip-Pipes?	" 2, 1884
What Candle-Power Coal-Gas can be Maintained by Enriching with Naphtha, introduced with Steam into a Retort, and which is the Best Method to Use Oil as an Enricher—and the Kind to be Used?	Apr. 16, 1885
Will Carbon Deposit as Fast, or be as Difficult of Removal With a Degree of Heat Necessary for Three-Hour Charges as Under a Heat Requiring Five Hours to Carbonize the Same Weight—Other Things Being Equal?	May 2, 1885
What is the Effect of Wet Coal on the Illuminating Power of the Gas made from it?	May 2, 1885
How many Cubic Feet of Gas is Represented by One Cubic Foot of Retort Carbon?	Mar. 16, 1887
How much Coke is Used, by Measure, to Carbonize 2,240 Pounds of Coal, with Yield per Pound?	Mar. 16, 1887
What are the Advantages of the Cartridge Method of Applying Enrichers?	Mar. 16, 1891
In Coal Gas Manufacture—Does it Pay to Work for Highest Yield or Candle Feet?	Mar. 11, 1901

Purification.

Is it Better and Cheaper to Use Iron Sponge, and allow the Carbonic Acid to remain in the Gas, and to make up the Deficiency by Using Oil, or to Use Lime Purification?	May 2, 1885
What Is the Cause of the Caking of Lime on Bottom of First Tray Before the Gas Shows Trace of Sulphur?	Apr. 16, 1886
How Many Thousand Feet of Gas, Under Favorable Circumstances, Ought a Bushel of Stone Lime, Slacked, to Purify?	Mar. 7, 1892
What is the Smallest Size of Purifiers that can be used Satisfactorily in W. G. Manufacture, Making 1,000 Cu. Ft. per Run, of 4 and 5 mins. Blowing?	Mar. 17, 1902

Storage.

What is the Effect of Cold on Transportation, and Storage of Petroleum and Distillates Used as Enrichers?	Mar. 11, 1895

Distribution.

What is the Best Way to Prevent a Gas Main Laid Across a Stone Culvert from Being Stopped Up in the Winter?	Mar. 16, 1887
What is the Proper Way for Estimating the Cost of Distribution of Gas?	Mar. 25, 1889
What is the Smallest Size Cast Iron Pipe that it is Policy to Lay?	Mar. 16, 1891
Should a Mile of 6 in. Main be Cast Iron with Lead or Cement Joints, or Wrought Iron with Screw Connections?	Mar. 7, 1892
What Advantage has Wrought Iron Pipe Over Cast Iron Pipe for Street Mains?	Mar. 19, 1894
Can Any One Give the Percentage of Fast Meters Found in Use?	Mar. 19, 1894
What Successful Substitute for Cast Iron Gas Mains has the High Price of Iron Developed?	Mar. 12, 1900
Method of Handling Money and Accounts from Pre-payment Meters,	Mar. 12, 1900
Would a Gas Inspector be Justified in Passing a Job that had been made Tight by Healing up a Leak by Cold Water Application?	Mar. 26, 1901
Is the Use of Pre-payment Meters Increasing, and Does it Pay?	Mar. 4, 1901
Has the Licensing of Gas Fitters Proved a Benefit to the Gas Companies in Boston?	Mar. 10, 1902

Lighting.

What is the Cause of the Clogging Up of Burner Tips in Houses That are Situated at the Dead Ends of Mains, and What is the Remedy?	May 16, 1885
What Burner is Best Suited for a Mixture of Coal and Water Gas?	Mar. 23, 1891

Heating.

What is the Average Amount of Gas Burned Per Annum by a Gas Range, and How Much has the Introduction of Gas Stoves Increased the Output of Gas?	Mar. 11, 1895
At What Price Per Net Ton Must Anthracite be Delivered to Compare with Gas at $1.00 per 1000 Cubic Feet for Cooking?	Mar. 26, 1900

Power.

How will the Gas Engine work to supply power for an Electric Light Plant?	Mar. 16, 1888

Residuals.

What is the Best Coke Crusher?	May 16, 1885
What Ought to Constitute an Average Yield of Tar per Ton of Coal Carbonized?	Mar. 7, 1892

Photometry.

What is the Effect of Change of Atmospheric Pressure on Candle Power of Gas?	Apr. 16, 1885

Chemical.

Has Any Member of the Association Personal Knowledge of a Gas Explosion in Any Room Situated Above the Basement Floor?	Apr. 16, 1886

Electrical.

Should the Electric Light be Treated as a Competitor or as an Educator of More Light?	Apr. 16, 1886
Can a Gas Company Afford to Devote its Attention to Electric Lighting?	Mar. 16, 1887

Management.

Is it Advisable to Dispense with Sunday Labor?	May 3, 1886
Is it Possible to Sell at $1 per Thousand Feet, and Pay Dividends, Without Making Coal Gas?	May 3, 1886
Will Lime that has been Slaked One Year Purify as Much Gas per Bushel as Lime that is Freshly Slaked?	Mar. 16, 1886
What Dissatisfaction is Caused Among Regular Customers by Making a Reduction to Users of Gas Stoves?	Mar. 24, 1890

Miscellaneous.

A New Company Commences to Make and Sell Acetylene Gas in Cylinders, Distributed by Wagon Service, in a City where the Existing Gas Company has a Charter for 30 Years, Giving it Exclusive Right to Make and Sell Gas. Can the Old Company, Under the Charter, Stop the New? Eh!	Mar. 14, 1898

THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

OFFICE OF THE SECRETARY.

Oct. 31, 1903.

DEAR SIR:

Will you kindly give the following your careful attention?

In accordance with the vote of the Association at its last annual meeting, your Directors have arranged with the Boston Society of Civil Engineers, for the keeping of our books in their Library and for the use of their books by our members.

The generous gift by Mr. Frederic Egner of three boxes of valuable books, together with several other contributions received and promised, give us the nucleus of an admirable "Gas Library." The Library is in

Room No. 715 Tremont Temple,
Tremont St., Boston,

and is now ready for members to use. It is regularly open from 9 A. M. to 5 P. M. By purchasing keys of the Librarian members can gain access to the Library at other times.

It can be used for consultation of its books, or as a reading room, for letter writing (Association stationery will be on the table) or for the meeting of friends by appointment.

A register will be on the table in which members are asked to write their names and date of visit so that a record of the Library's use may be had.

The Secretary has been instructed by the Board to ask members to send in duplicate copies of printed forms used by them in the business of their Companies. These will be arranged in some convenient manner for reference and if members respond freely to this suggestion an exhibit can be made, which will be of great value and interest.

Two sets are asked for, to provide for two methods of grouping.

Where forms are printed on both side *four* copies of each one should be sent.

Yours very truly,

N. W. GIFFORD, *Secy.*

RULES

The Directors of the Association are the Library Committee.

The Secretary of the Association is the Librarian.

The Directors adopted the following Rules Oct. 31, 1903.

Books and periodicals may be used in the Reading Room by members and their friends.

Members may borrow books for home use, but no one shall have more than four books at any one time, nor keep them more than five weeks.

A member borrowing a book shall sign a receipt for it in a book kept for the purpose in the Library and shall cancel such receipt by entering the date when the book is returned.

Current numbers or unbound files of periodicals shall not be taken from the Library unless by permission of the Librarian.

Any person mutilating or losing a book shall pay for the damage or replace the book.

Any one who violates the above Rules, shall, upon the written request of the Librarian to the Directors, be debarred from the privileges of the Library for such time, not less than three months, as the Directors shall determine.

LIST OF BOOKS IN THE LIBRARY

OCTOBER 31, 1903.

American Gas Light Journal. Vols. 61 to 69.

Appleton's Cyclopædia of Applied Mechanics. Two vols.

All American Gas Wrinkles.

Card Catalogue of Current Gas Literature. (*Promised*).

Coal Gas. A Practical Treatise, etc. Samuel Clegg, Jr.

Coal Gas. Analysis, etc. W. R. Bowditch.

Coal Gas and Ammoniacal Liquor. Distillation of, etc. George Lunge Ph.D., F.C.S., etc.

Digest of the Decisions of Law and Practice in the Patent Office. D. H. Rice and L. C. Rice. Two vols. in one.

Dynamo–Electrical Machinery. S. P. Thompson.

Elements of the Theory and Practice of Chemistry. 1758. Two volumes.

Encyclopædia of Chemistry. Lippincotts' Pub. Two vols.

Economical Gas Apparatus Construction Co. The Catalogue of.

Field's Analysis

Fuel. Its Combustion and Economy. D. Kinnear Clark, M. E.

Gas Works: Their Arrangement, Construction, Plant and Machinery. Frederick Colyer, C.E.

Graham on Coals. (*Promised*).

Guide Framing of Gasholders and Strains in Structures Connected with Gas Works. F. S. Cripps.

Hand book of Industrial Organic Chemistry. Samuel P. Sadtler, Ph.D.

Handy Book for the Calculation of Strains in Girders and Similar Stuctures. William Huber, C.E.

Hearing. Holyoke Water Power Co. *vs.* City of Holyoke. Twenty-two vols.

Keister's Corporation Accounting and Auditing. D. A. Keister.

King's Treatise on the Science and Practice of the Manufacture of Coal Gas. Three vols.

Law of Incorporated Companies, Operating under Municipal Franchises. A. R. Foote and C. E. Everett. Three vols.

Lowe Standard Water Gas Apparatus.—United Gas Improvement Co. Catalogue.

Proceedings of

American Gas Light Association. Nineteen vols.

American Society Civil Engineers.

Boston Society Civil Engineers.

Kansas Gas Association.

Pacific Coast Gas Association.

New England Association of Gas Engineers. Complete.

Western Gas Association. Three vols.

Texas.

Report of Gas Associations England and Scotland, 1886.

Robinson on Patents. William C. Robinson, LL. D. Three vols.

Roof Trusses. C. E. Greene, A.M.C.E.

Standard Electrical Dictionary. T. O'Conor Sloane, M.A.

Sulphuric Acid and Alkali, etc. George H. Lunge, Ph.D., F. C. S. Three vols.

Text Book of the Patent Laws of the United States of America. A. H. Walker.

Treatise on Masonry Construction. I. O. Baker, C.E.

(A)

TO THE

New England Association

OF

GAS ENGINEERS.

I desire to become an Active Member of your Association, and respectfully submit this application therefor. And agree, if elected, to conform to the requirements of the Constitution.

.... (NAME OF APPLICANT)

.... (POSITION HELD BY APPLICANT)

.... (NAME OF COMPANY APPLICANT IS WITH)

.... (ADDRESS OF APPLICANT)

....

....

Date,...19...........

We hereby approve and endorse the above application for Active Membership.

.... *Active Members.*

....

Approved by Directors,..

Date of Election,..

....*Secretary.*

(C) **APPLICATION BLANK—TRANSFER.**

TO THE

New England Association

OF

GAS ENGINEERS.

The undersigned associate member of the Association respectfully asks to be transferred to the class of active members.

.... (NAME OF APPLICANT)

.... (POSITION HELD BY APPLICANT)

.... (NAME OF COMPANY APPLICANT IS WITH)

.... (ADDRESS OF APPLICANT)

....

....

Date, ... *19*........

We hereby approve and endorse the above application for Active Membership.

.... } *Active Members.*

....

Approved by Directors, ...

Date of Election, ...

.... *Secretary.*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